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The Hobbing of Molding Dies

By T. I. Phillips

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Hob pressing insures duplication of dies —Method of hobbing—Life of the hob— Machining hobbed tools—Examples of work

THE hobbing, or pressing, method of making dies is used largely where duplication of the die is necessary, or in pressing odd-shaped depressions in tools that are used for molding such items as bakelite radio tube bases or panels. The pressing of odd-shaped holes in molding dies is not only cheaper, but it also results in absolute duplication where multiple molds are used.

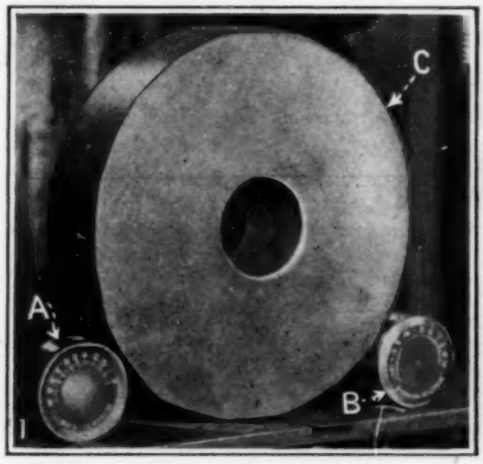
The machine used for hobbing is a 24-in. vertical ram hydraulic press with a pump capable of exerting a 2,000-ton pressure on the ram, although the pressures necessary to do the work here described range only from 100 to 500 tons.

A hobbed piece is shown at *A* in Fig. 1, the hob at *B*, and the matrix, or holding ring, at *C*. A miscellaneous lot of hobbed tools is shown in Fig. 2. The piece to be hobbed is inserted in the matrix, with the surface to receive the impression up. The master, or hob, is then placed in position, face to the work, and the whole placed in position on the ram. The guard is next closed, and the pressure applied. After pressing, the ram is used to remove the work from the matrix.

The master, or hob, is made from a good grade of tool steel, carefully machined, hardened and polished. Masters for parts requiring lettering are engraved on an engraving machine. For work requiring depressed lettering, or graduations, the original tool is engraved with the depressed lettering, and the pressing master is itself pressed from this original in order to obtain a master with raised letters. Not more than three or four tool steel impressions can be obtained from the same original without affecting the clearness of the impression.

The matrix is necessary to keep the work under the hob, and to prevent the flow of pressed metal sideways into a flattened mass. It is made of nickel steel, heat-treated, and the hole is tapered about four degrees to enable the easy removal of work after pressing. The matrix is made with a heavy wall to withstand the pressure exerted on the sides of the hole.

The pressed pieces, which are usually inserts for a die or mold, are made from iron or soft steel which has been cut to length and machine finished on two faces. The face to receive the impression is highly finished with emery cloth and crocus, all scratches and tool marks being removed. It is important to clean carefully the face of the work and the hob before pressing, as any dirt will mar the work.



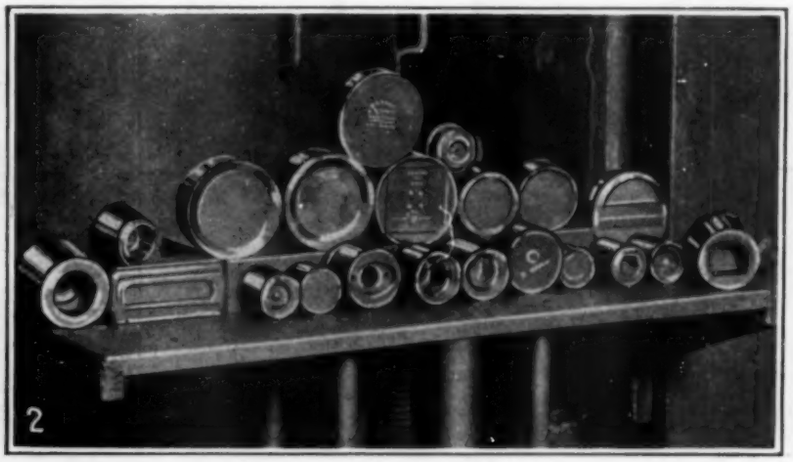


Fig. 1—Hobbing tools and work. Fig. 2—Samples of hobbed dies

After hobbing, the piece is machined for other sizes, working from the hobbed face, sufficient stock being left for grinding at fitting points. It is then carbonized to a depth of about $\frac{1}{8}$ in. All scale, carbon, or dirt is removed from the face after carbonizing. The piece is next heated to the proper temperature and hardened. After grinding the fitting parts, and polishing on the molding surfaces, the hobbed insert is ready for assembly.

In Fig. 3 are shown the top and bottom of a mold for producing the panel of a radio receiving set *A*. This mold has hobbed inserts, and in Fig. 4 is shown the bottom section all carefully ground, ready to receive the hardened inserts. In Fig. 5 is illustrated the arrangement of the hob in the hydraulic press for pressing the mold inserts.

The tools for the hobbing of dies are simple in theory, but the secret of successful operation is in careful workmanship in the die, and care in setting and cleaning the tools on the part of the hobbing press operator.

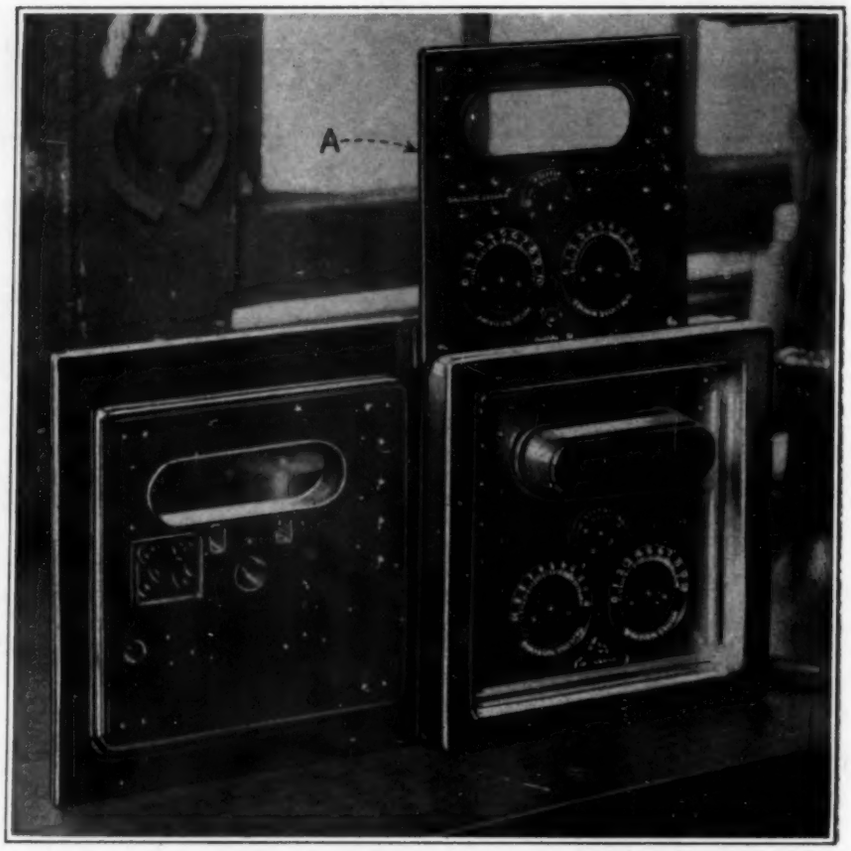
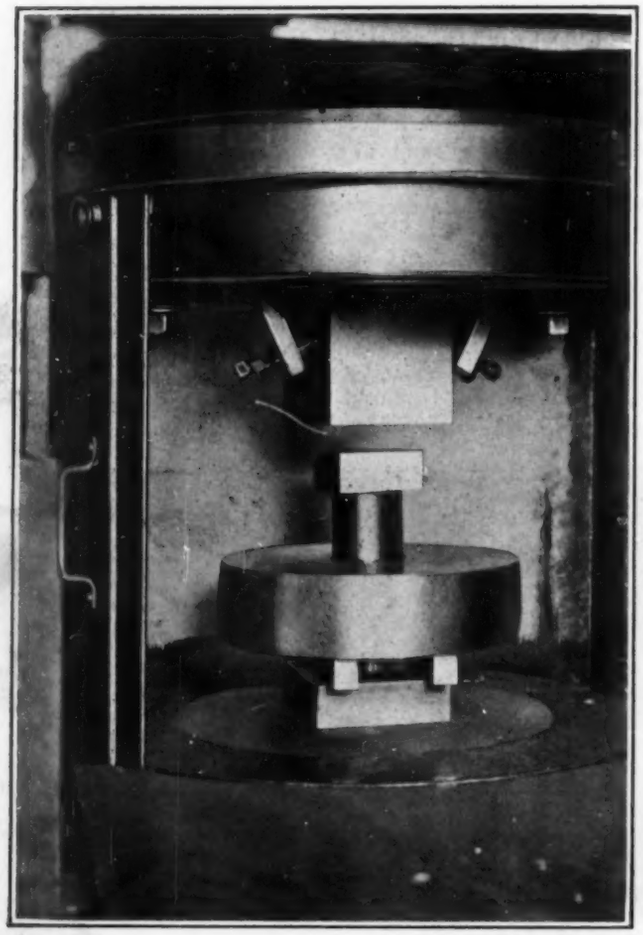
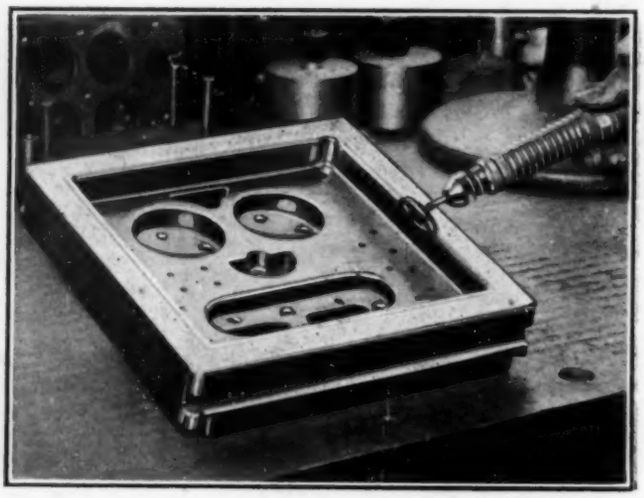


Fig. 3—Molding die for radio panel (Above)

Fig. 4—Molding die block (Below)

Fig. 5—Press arrangement for hobbing (At left)

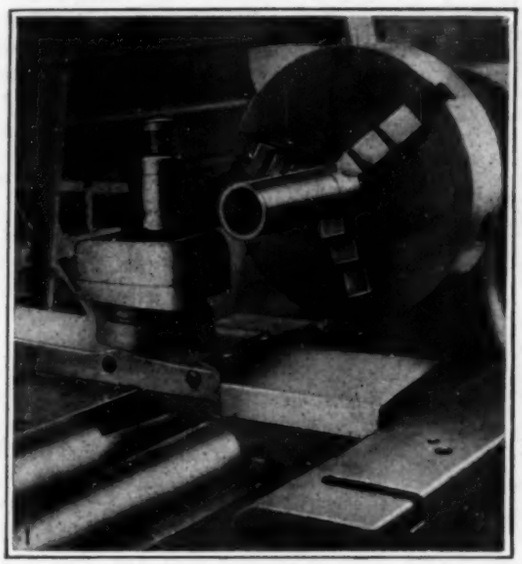




Welding Equipment and Air Tools Decrease Locomotive-Repair Costs

By Frank W. Curtis
Western Editor, *American Machinist*

Reconditioning and reclaiming flues—Air-operated device for expanding flues—Counterboring wheels — Cleaning water heaters — Air-operated clamp



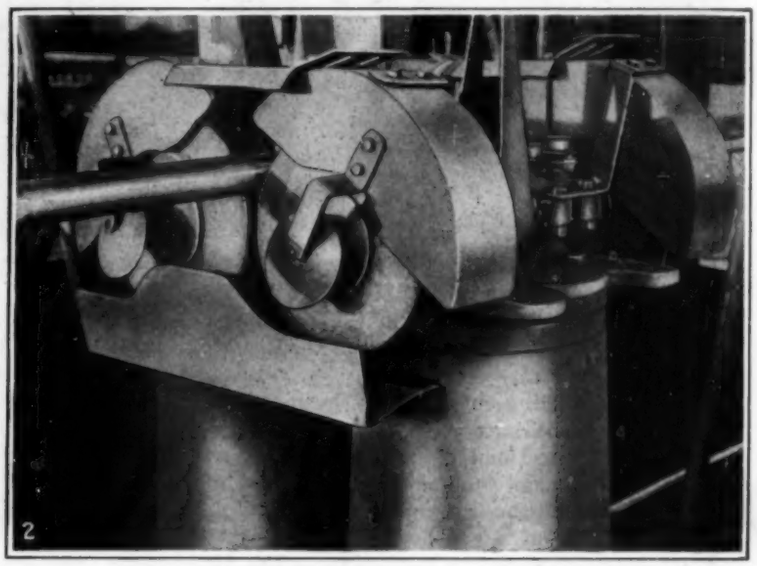


Fig. 1—Cutting off safe ends. Fig. 2—Grinding ends of flues

METHODS of handling flue repairs differ in railroad shops, generally on account of the equipment available. In some shops, this class of work often retards locomotive repairs. One of the marked exceptions is afforded by the Topeka shops of the Atchison, Topeka and Santa Fé Ry. System where flues are handled in an efficient manner. Special efforts have been made to reduce the cost of reconditioning flues with the result that in place of always being behind in keeping up to the required schedule, the work now is completed almost as soon as it is received in the flue department. By installing a small amount of equipment with original features, the reclaiming of flues also is made possible, thereby avoiding the scrapping of short flue-lengths.

After the flues have been removed from the boiler they are cleaned, and put through a thorough inspection to determine their condition and the repairs that are necessary. If it is found necessary only to apply safe ends, the flues are placed in a special rack, signifying this class of repair. When the flues are in a worn condition and contain thin sections that are beyond further use, the procedure is to cut out the useful portions and pile them in a separate rack. Some of these sections are used for the making of safe ends as shown in Fig. 1. The work is fed through the spindle of the lathe and cut to the desired length with the usual type of cut-off tool.

Since a butt-welder is used for the application of safe ends, it is necessary to provide a smooth surface on the safe end and the portion of the flue that is held in the copper jaws of the welder to form a satisfactory electrical contact. For this operation, the flues are ground on a specially constructed machine shown in Fig. 2. The machine has two sets of abrasive wheels mounted on a base that may be adjusted so the center distance between the wheels can be set in accordance with the size of the wheel and to compensate for wear. The flue is ground by placing it between the wheels that run in an upward direction. The operator revolves the work as well as moving it in and out to grind approximately 7 in. of the end. The outer end of the flue is supported by an adjustable stand that presents the work at a proper height. Two operators, one on either side, use the machine at the same time.

In the event the work runs through in quantities so small that only one operator is needed, grinding is divided between the two sets of wheels to cause even

wear. One of the features of the machine is the possibility of using worn abrasive wheels from tool grinders throughout the shop. Such wheels which were formerly discarded now are used for flue grinding, thus making possible an operation without tool expense.

As safe ends would be difficult to handle in this manner, they are tumbled for a period of ½ hr. This operation cleans the scale from the outer surface and leaves it with sufficient polish to form a satisfactory contact for welding.

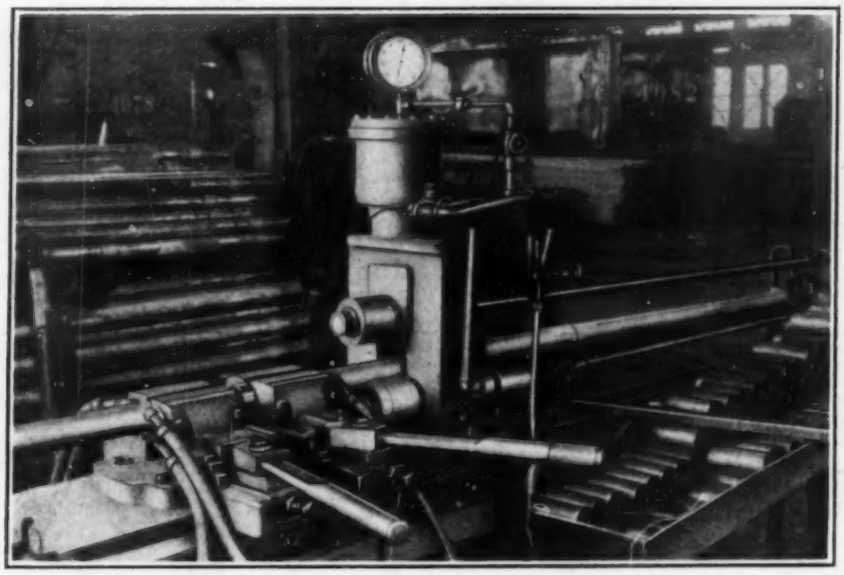


Fig. 3—Welder equipped with rolling attachment

Instead of joining flue sections by means of an oil-fired furnace, the butt welder, shown in Fig. 3, now is used. The sections of the flue to be joined are clamped in the usual type of copper jaws as illustrated. After the weld has been completed and while the welded portion remains at a red heat, the flue is rolled by a special device fastened to the welder. The attachment consists of a taper plug over which the flue is forced, while directly under the plug there are mounted two stationary rolls. A third roll, operated by an air cylinder, is located over the plug. In operation, the flue is slipped over the end of the plug so the welded portion is in line with the two lower rolls. Then the air-operated roll is brought in contact with the flue by means of a lever, the same movement causing the plug and flue to revolve. A gage is mounted on the air cylinder to show the pressure that is being applied.

By the use of this device the inner and outer flashes, produced by the butt welder, are rolled out, leaving the surfaces of the flue approximately smooth. The rolling action also tends to form a more uniform weld. The machine is used for handling the regular run of flues requiring safe ends and also for the reclaiming of the smaller flue lengths. The operator matches short pieces to form full-length flues, which are welded in quantities sufficient to make extra sets of flues. For example, some flues have three welds, three sections of which are made of salvaged lengths and the fourth portion is a safe end. This method of handling the work has made possible a substantial repair as well as a reduction in handling cost per flue. The equipment shown is used for reconditioning and reclaiming 2- and 2¼-in. flues. Similar installations now are being made to handle super-heater flues.

An improved form of air-operated flue expander is shown in Fig. 4. The device consists of an air motor fastened to a strap bracket that is clamped on the front end of the smoke box. On the driving end of the motor is a double universal-joint shaft on the end of which is located a standard form expander. The tool can be moved in any direction within the smoke box. As the center shaft has a square telescoping drive, the tool can be used to roll flues of boilers that are located at different distances from the front face of the smoke box. In order to operate the unit from the inside of the engine, a control lever of suitable length is connected to

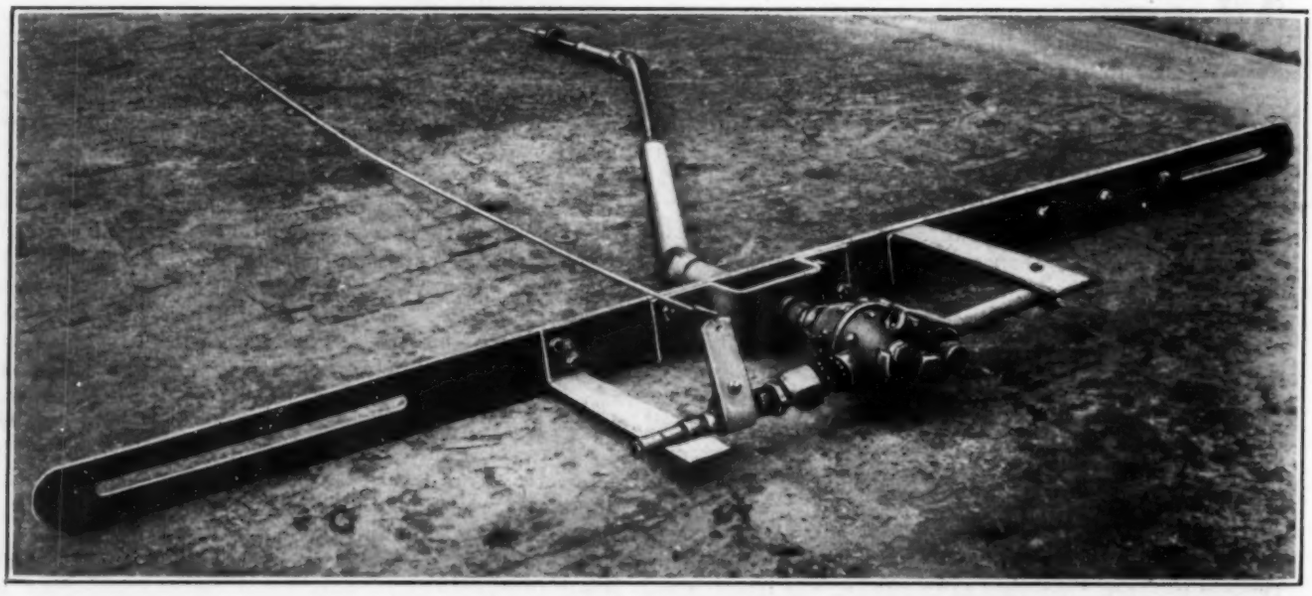
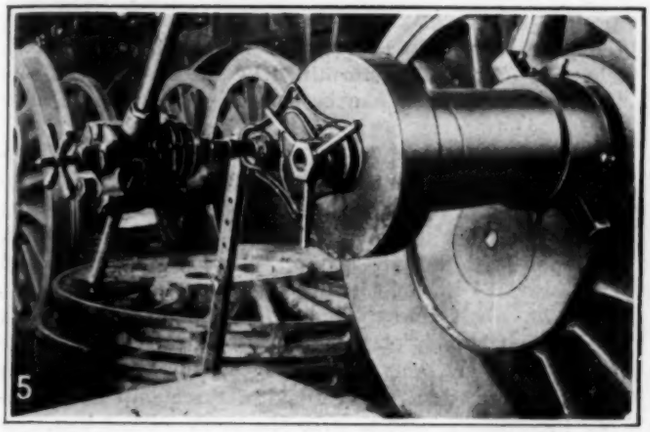


Fig. 4—Device for rolling flues



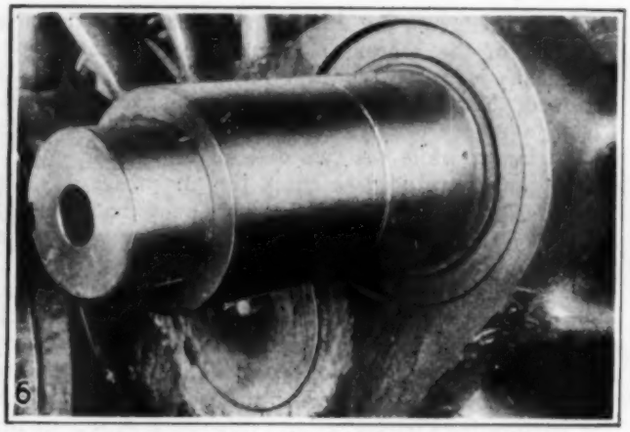


Fig. 5—Counterboring wheels for floating bushings. Fig. 6—Completed counterbore on wheel

a strap that is fastened on the operating valve of the air motor. The motor is held stationary on the strap bracket by means of two supports as shown.

Another air-operated device that has made possible a direct saving in time is the tool for counterboring wheel hubs shown in Fig. 5. The unit counterbores a recess 1¼ in. in width and ⅜ in. in depth for use in connection with floating bushings of connecting rods. The former procedure necessitated the removal of the main driving pin from the wheel to machine the recess either on a horizontal boring mill or rod-boring machine. With this attachment the recess is cut without the necessity of removing the pin.

The unit is comprised of a sleeve that fits over the driving pin, having a bearing at the inner end consisting of split liners that bear on the surface of the pin. A double-recessing tool holder is mounted on the inner end of the sleeve as shown. The unit is held in place by a bar that passes through a hole in the driving pin and is held on the inside of the wheel by check nuts. On the outer end of the bar is fastened a feed screw used for drawing the entire unit inward. A strap clamp is used to support the end of the unit against the cutting pressure, this strap being adjustable to suit the position of the driving pin. In operation, the air motor, fastened to the driving spindle, operates the sleeve through gearing while the bar and outside end frame remain stationary. Then, as the operator

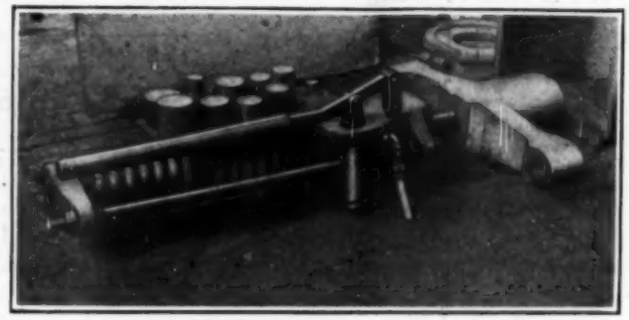
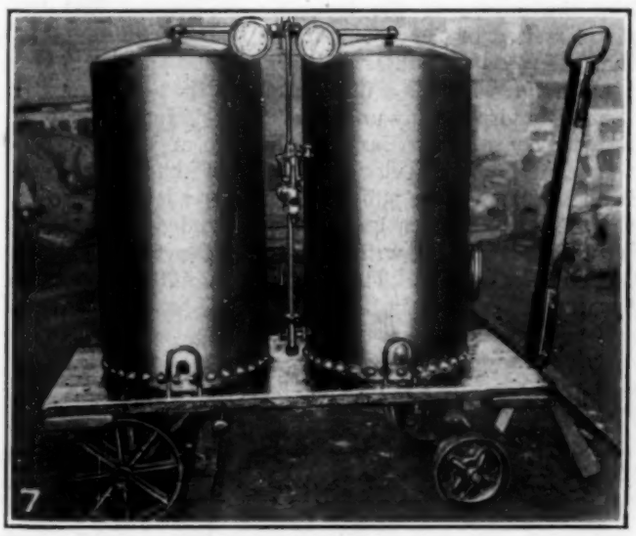


Fig. 8—Floor-type hydraulic press

turns the feed screw the sleeve is drawn inward until the counterbore has been cut to the desired depth. In Fig. 6 is shown the work after completion.

A specially constructed portable unit for cleaning and washing feed-water heater-tubes is a recent addition to labor-saving devices in the shop. As shown in Fig. 7 the outfit comprises two 60-gal. tanks mounted on a platform truck. One of the tanks is filled with a solution of 20 gallons of water and 6 gallons of commercial muriatic acid. A connection from each tank is made to the heater to form a continuous circulating channel. An air hose from the shop air-line is connected to a reducing valve located between the tanks so that the operating air pressure can be cut down to 20 lb. The



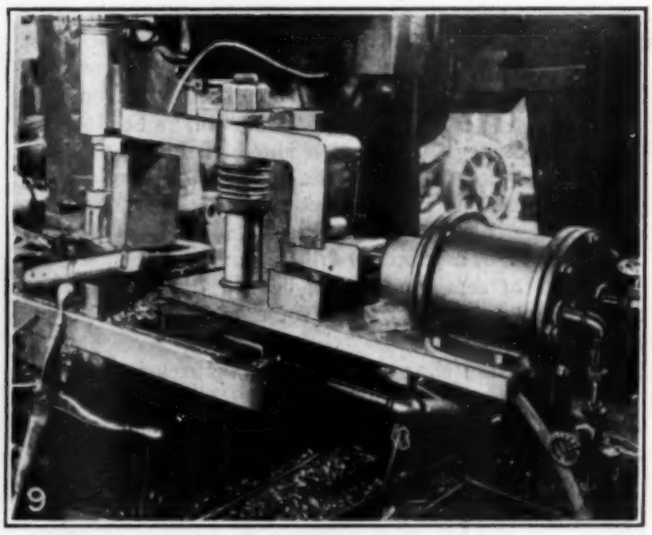


Fig. 7—Tanks for cleaning heater tubes. Fig. 9—Air-operated clamping device

air pressure forces the solution from one tank through the flues of the heater and back into the other tank. By means of a three-way valve, the operation is reversed. The approximate time for one cycle is 1 min. Glass gages are used to show the level of the solution in the tanks, while the two dial gages, located on top of the tanks, are used to check the air pressure being applied. This method of cleaning the tubes has not only simplified the operation but has made easy work of a rather unpleasant task.

A home-made hydraulic press of unique design, shown in Fig. 8, is used for miscellaneous purposes such as pressing bushings into spring hangers, equalizers, engine hangers and similar work. The advantages are that it is not necessary to lift the work from the floor for performing the operation. The part shown in the illustration is a spring hanger. A backing-up plate or anvil is built in the floor to take the pressure applied against the work. When bushings are to be removed, the plugs shown in the rear of the machine are used. The size of plug is determined by the diameter of the bushing. The press can be controlled so either a slow or fast motion can be applied.

Throughout the shop may be seen a number of air-operated clamping devices that permit the rapid handling of work on milling machines, drill presses and other machine tools. Fig. 9 shows a drill press, equipped with an air clamp, set up for drilling and reaming a 3¼-in. hole in the tank-truck spring hanger. An 8-in. air cylinder is provided with an operating wedge that travels on rollers located in the bottom support and in the clamp. Movement of the cylinder forces the wedge to raise the heel end of the clamp thus causing the opposite end to grip the work. Steel blocks to suit the size of the work that is being handled are used under the clamps.

Proportioning the Constituents of Babbitt Metal

By L. D. Allen

IN the manufacture of alloys for bearing liners, it is important that only such constituent metals be used as will produce a smooth mirror-like bearing surface. Of these constituents, lead is the most pliable and unctuous in its contact with the journal or shaft. Lead itself is too soft to carry the load, consequently it must be strengthened by the addition of antimony for hardening and tin and copper for both hardening and toughening. Tin also serves as a solder to unite or bind together the ingredients of which the alloy is composed.

Bearing metals should never be bought on cost but on their adaptability to the conditions under which they are to serve. The more dense or compact the body of the bearing liner, the less it will compress under journal pressure. Vibration, a destructive agency, usually occurs where a metal compresses and creates excessive space between the journal and the bearing surface. For this reason all bearing metals should be triple alloyed under careful laboratory supervision. A slight variation in the ingredients and the manner of combining them will change the metal from a dense, compact, homogenous alloy to a coarse-grained, mechanical mixture of ordinary quality, or worse.

Extensively conducted tests in research laboratories have proven that the maximum load per sq.in. on any type of bearing must not exceed 2,500 lb., and that most of the machinery in operation should not carry a load in excess of 1,500 lb. per sq.in. If the bearings are of proper dimensions with respect to the length, the diameter and the thickness of the liner, and positive lubrication is assured, a process-hardened and toughened babbitt metal of semi-tin or lead base would be the most durable and economical metal for a load of 1,800 lb. per sq.in. and under.

Alloys of this character show a compression test on a one-inch cube of 16,000 to 20,000 lb., but they will not stand in excess of 1,800 lb. per sq.in. on a liner ⅛ or ¼ in. in thickness.

There are concerns using, in extremely severe bearing conditions, what is known as "Genuine Babbitt," simply because of its toughness or bending strength. "Genuine" babbitts range from 80 to 90 per cent tin. A moment's reflection will suggest that very rarely are bearing liners subject to bending stress. In most requirements a metal made low in tin that will stand the load pressure of the journal or shaft without giving or cracking and that will not heat from journal friction, would be the best metal to use.

I have replaced tin-base babbitts of the "Genuine" character in many cases with process toughened and hardened alloys containing 25 to 50 per cent less tin at a proportionately lower cost to the user. Longer wear resulted and the drag or pull in the operation of the machinery was reduced. These metals were of sufficient strength to carry the load, and because they contained a higher percentage of lead, they ran cooler.

For example: A large woodworking company invited me to visit their East St. Louis plant where trouble with the bearings of overhead drives was being experienced. I asked the superintendent what babbitt metal he was using in the bearing that he pointed out as giving him the most trouble. He stated that it was a "Genuine Babbitt" of about 88 per cent tin. I asked him the nature of the trouble. He replied that the metal melted or fused out of the bearing. I told him that the reason for this was the fact that the metal was high in tin, which is a dry metal and that consequently it heated more rapidly under journal friction than would a metal containing a large percentage of lead. A further contributing factor was the fact that these overhead bearings were subject to more or less neglect in the matter of lubrication. I recommended a hard lead-base babbitt metal with a compression test of about 18,000 lb. per sq.in. This advice was followed and the trouble ceased, simply because the lead-base babbitt ran cooler than the tin-base babbitt.

An example of how little savings accumulate into big ones comes from a maker of cast-iron radiators. By using patterns that had been machined all over he saved a pound of metal per square foot of radiating surface. And he makes several million square feet of radiators per year. The cost of machining is repaid many times over.

Drawings Are Made and Handled Economically by the Morgan Method

By Theodore H. Nye
Engineer, Morgan Construction Co.

Standardized sizes of drawings and title forms have been adopted — Three indexes are used, each of which fills the nine requirements for a perfect index of drawings

IN THE development of mechanical drawings, the inventive mind has selected almost numberless sizes of paper to graphically record ideas. Convenience for the particular problem at hand dictated the form and size. In the early days, and in rare cases today, the one copy was used without duplication for construction, and having served its purpose, was destroyed.

Our own inventive age, with widespread use of unnumbered details demanding quantative production, requires the use of many copies of many drawings. A new problem has arisen. Convenience for duplication and handling and filing, economy in the production of the used copies, and ease of transportation must be given attention.

Duplication today is principally carried on by two processes, blueprinting and photostat copying. Special machines for either method have limits of sizes for the particular plant use. Initial cost, maintenance, and power usage increase at least by the square of the machine size, hence the smallest practical unit to handle the largest drawing dimension must be selected.

Handling and filing of drawings in quantities are perhaps the most evident factors calling for the best selection of form and size. Handling of a group of prints arranged for a particular machine or for a field job is best facilitated by one shape and size. Even though not bound together, an odd-size print is not easily found among the others. Economy of filing space and convenience of selection of a print demand a uniform size or group of sizes. The selection of the sizes in a group such that all larger sizes are multiples of one or both dimensions of the smallest provides for the most economical arrangement of filing cases.

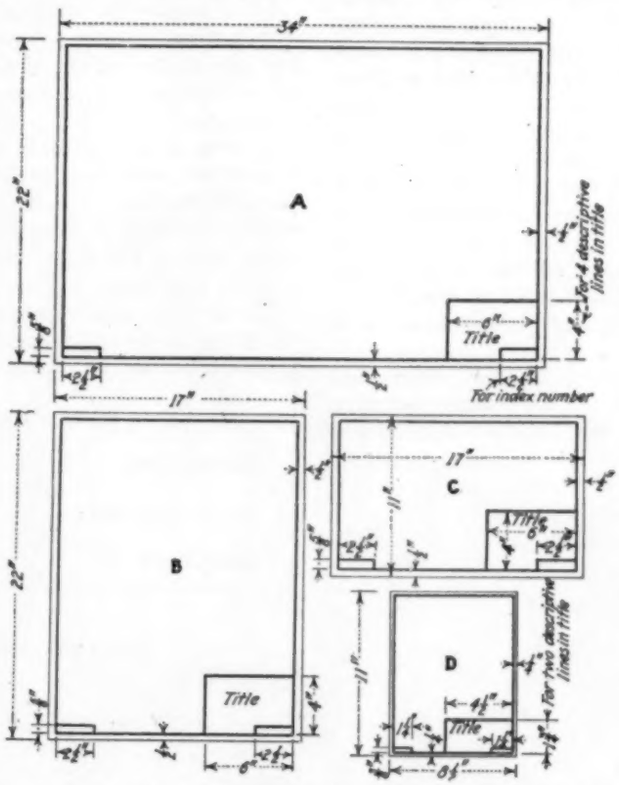


Fig. 1—Morgan Construction Co. standards for drawing sizes

Economy of material for both the original and its copies are real problems today. The guide in selecting a drawing size is the size of paper provided by the paper manufacturer. The unit drawing size may be either the largest of the group or the smallest. In either case the larger sizes must be multiples of the smallest either for one or both dimensions. The largest drawing should conform to or be a divisor of a standard sheet manufactured in the paper mill. There is, then, no waste for original, and, what is more important, no waste in the print stock. Dollars and cents enter prominently into this consideration and cannot be overlooked any more than they can be ignored in any other department of a modern industrial organization.

Many copies of drawings are forwarded by mail and express. Here, too, a careful selection of the drawing size is important. Prints are usually accompanied by a letter. If the letter and smallest print are of the same dimensions then the larger prints may be folded to the same size and economically and safely placed in the same inclosure for transportation.

Careful consideration of the foregoing factors has led the Morgan Construction Co., of Worcester, Mass., to select the following overall dimensions for its drawings as shown in Fig. 1: *A* — 34x22 in.; *B*—17x22 in.; *C*—17x11 in.; and *D*—8½x11 in.

Based on 8½x11 in. as a unit, this size being a divisor of a standard paper size, and the common size for letter paper, the drawings and prints are:

(a) Convenient for handling
(b) " " stacking
(c) " " filing

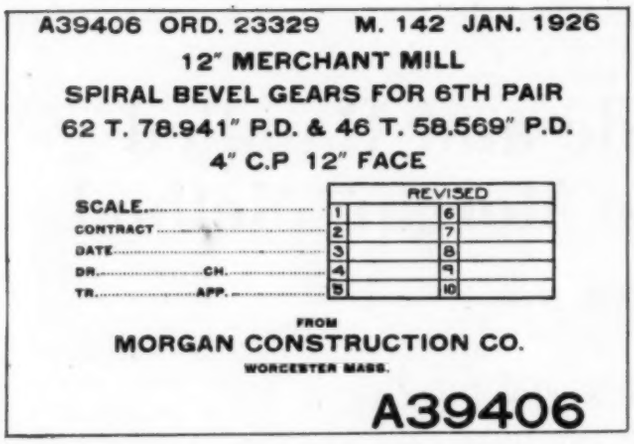


Fig. 2—Form for corner card for drawing, which is also printed on white cardboard for 4x6-in. card index files

(d) Easily duplicated in available blueprinting and photostat machines
(e) Printed without waste from stock sizes of printing paper
(f) Mailed in standard envelopes of one size carrying both letters and prints.

The adoption of standard paper sizes for drawings is not new. Germany, Austria, Belgium, Holland, and Switzerland have selected national standards, and Sweden, Norway, Czechoslovakia, Finland, and Poland have the subject under consideration.

Type sizes for the index numbers have been standardized by the Morgan company, 30-point type being used for the index numbers of *A*, *B*, and *C* drawings and 12-point type for *D* drawings. The index number is always located in both the lower left-hand and lower right-hand corners. In the right-hand corner the index number becomes a part of the title card.

On *A*, *B* and *C* drawings a space 4 in. high and 6 in wide is devoted to the title and descriptive lines. On the *D* drawings the space is 1¾ in. high and 4½ in. wide. Four descriptive lines are permitted on the *A*, *B* and *C* sizes, and two descriptive lines on the *D* size. The title card for an *A* drawing is reproduced in Fig. 2 to reduced scale.

Where a progressive industry designs diversified products and where quality rather than quantity requires a constant supply of new details covering new ideas, the effective indexing of its drawings is a real problem. An index must be:

(a) Simple in arrangement
(b) Promptly available
(c) Accurate
(d) Complete
(e) Easily maintained
(f) Not readily disturbed
(g) Not burdened with useless data
(h) Readily expansive
(i) Inexpensive.

In conjunction with the printing of titles on drawings with metal type the Morgan Construction Co. has successfully inaugurated a drawing index that seems to comply with all of the rules previously mentioned.

After the drawing is titled and with the unchanged form in the press, and without change of makeready or the position of the gages, 4x6-in. cards are printed in sufficient number to file one in every place where future search may be made for that particular drawing. The top line of the card, shown in Fig. 2, is not on the drawing. It is printed by a second impression and is added to assist in using the card in the index. The bold-type drawing number at the bottom of the card is not readily visible in the filing case, and when repeated in the added top line is the first thing seen. Factory order number of the machine, mill number, and date of drawing complete the card. The blank form under the title for scales, date, and revisions adds nothing to the value of the card, but, to save time, is never removed from the press.

The following indices are provided:

(1) Consecutive drawing numbers
(2) Companies for which the drawing was first used, grouped by machines, and arranged by dates
(3) A subject file including both machines and details.

(1) and (2) each take one card only. (3) may require several cards.

No typing of any kind other than the tab cards, and no handwriting are required. As a consequence, errors of copying are eliminated and labor is saved. The cards are ready and filed coincident with the finishing of the drawing. With a print of the drawing before him, the filing clerk, one who must be conversant with the drafting room needs, places cards in their respective files, the work of but a few moments. At any later time, a card may be inserted in any place deemed necessary, an exact copy being sometimes used as an emergency.

As a precaution against cards being taken out for examination and not properly replaced, a single hole is provided at the bottom of all the blanks before printing, and a locking bar is passed through them when filed in the case.

As soon as a tracing is completed one print is made, is stamped with the words "Office Print," and is put into the drafting room cage. Draftsmen and designers are charged with prints taken from the cage, the record being kept by the cage attendant on the form shown in Fig. 3. Page boys are provided to run errands for the drafting room employees, their duties including collecting prints from and returning them to the cage.

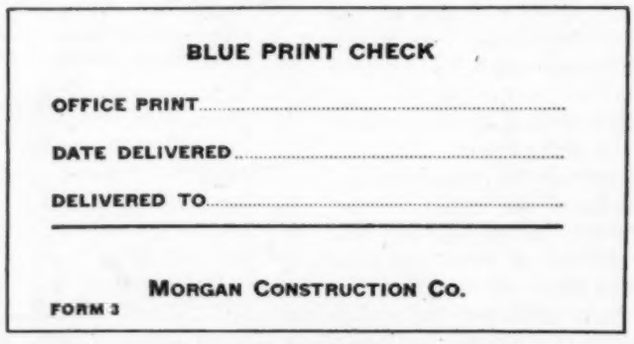


Fig. 3—Blueprint check used by draftsmen and designers

Four blueprints of each tracing are sent to the superintendent who has three of them distributed to the pattern, tool, and foundry departments and retains the fourth in his file, for use in the machine shop. A card record is kept in his office to show the locations of the three prints. When the file copy is taken out of the office, a tab, carrying the number of the man who is to use it, is placed in a pocket of the drawer.

Automotive Production

High Production Machines in the Automobile Shop

The Osterholm automatic surface grinder for the rapid and accurate finishing of cast pieces — Description of machine — Typical jobs

GRINDING as a means of removing large quantities of metal from the rough to leave a finished surface without preliminary cutting operations has been developed only within the last few years. The automobile industry, which is under increasing pressure to reduce labor costs, offers one of the best fields for this class of grinding, although the latter is also well adapted for replacing machining operations on pulleys, sad irons, parts of harvesting machinery, and many articles of a similar nature. The surface grinder, when fitted for this work, is strictly a production machine. It must be equipped for the mechanical operation of its minor functions, so that when once started the cycle completes itself and the work is brought automatically to the unloading position. When these conditions are fulfilled it is obvious that the need of highly skilled operators will be eliminated, and one workman can operate two or more machines in production.

An example of the production surface grinder adopted by some of the larger automotive shops is here described in the Osterholm automatic surface grinder, shown through the courtesy of Williams, White & Co. This machine is entirely automatic in its operation, and when employed in the grinding of such parts as exhaust port castings, the time of the operator is occupied only with loading and unloading.

The machine, shown in Fig. 1, has a cast-iron bed of sufficient weight and rigidity to absorb all vibration from the grinding. The work table is supported on a heavy cast-iron trunnion which oscillates on heavy bearings in the base. The table is raised and lowered by means of a heavy cam on the side of the machine. This same cam also determines the speed and amount of travel of the wheel housing. The raising and lowering of the work table bears a definite relation to the revolutions of the grinding wheel, and the cycle, or time in which the work table is in an operating position, may be altered by changing the change gears on the left-hand side of the machine. Rigidity is the keynote in all of the automatic movements of the parts of the machine in order to ensure complete accuracy in the finished work.

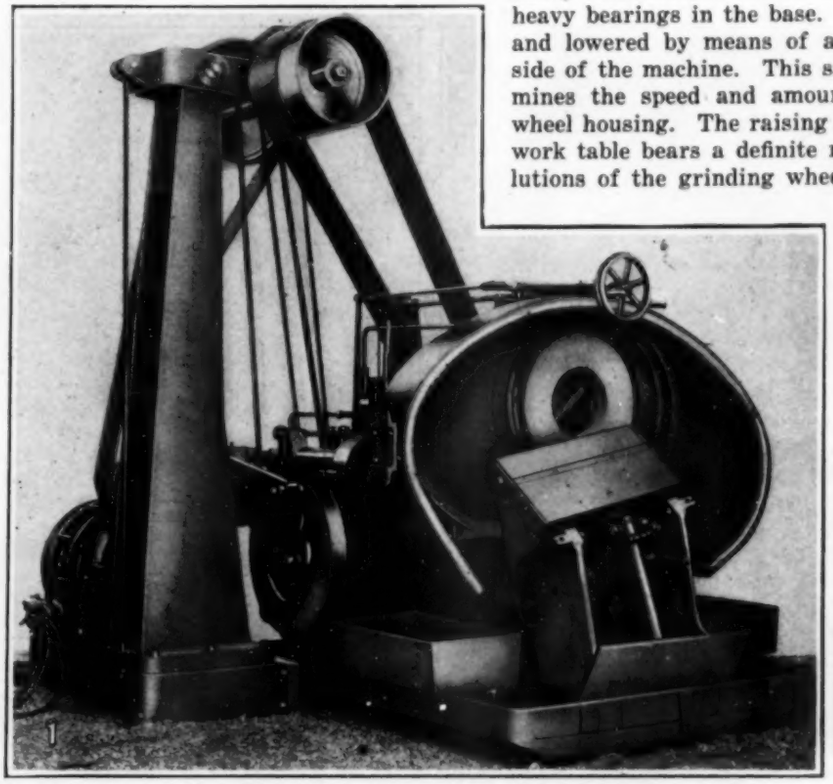
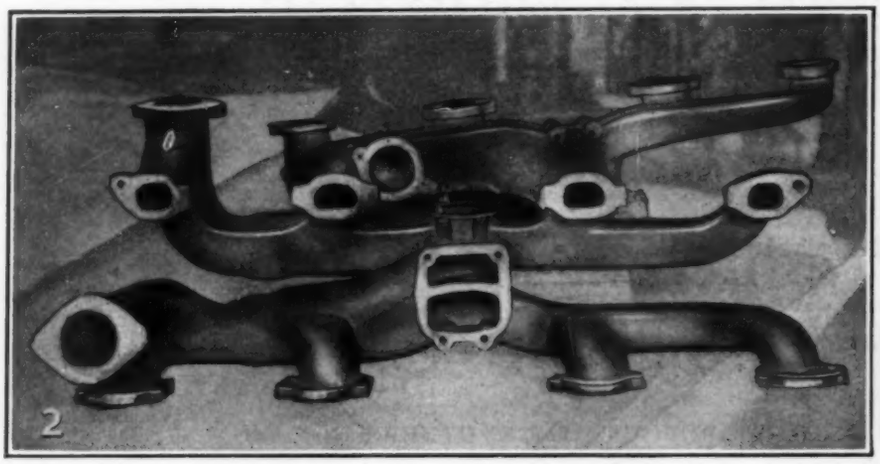
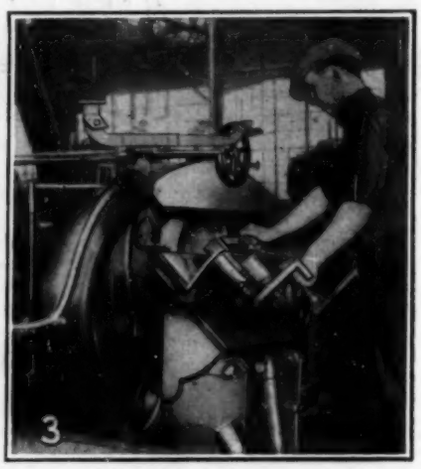


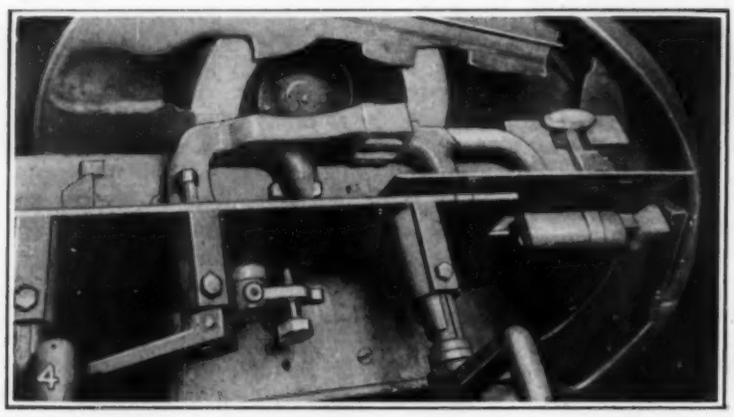
Fig. 1—Osterholm automatic surface grinder

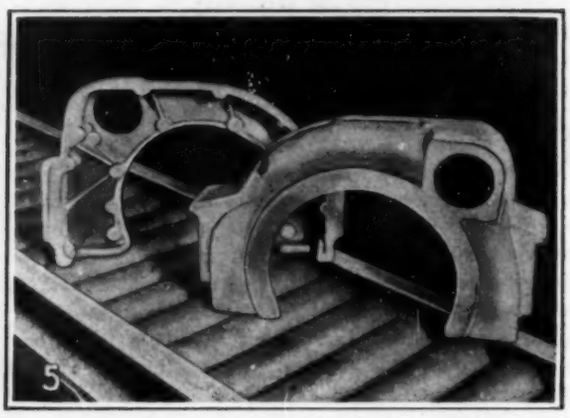
Plain water, or a soda solution, is used to flood the work

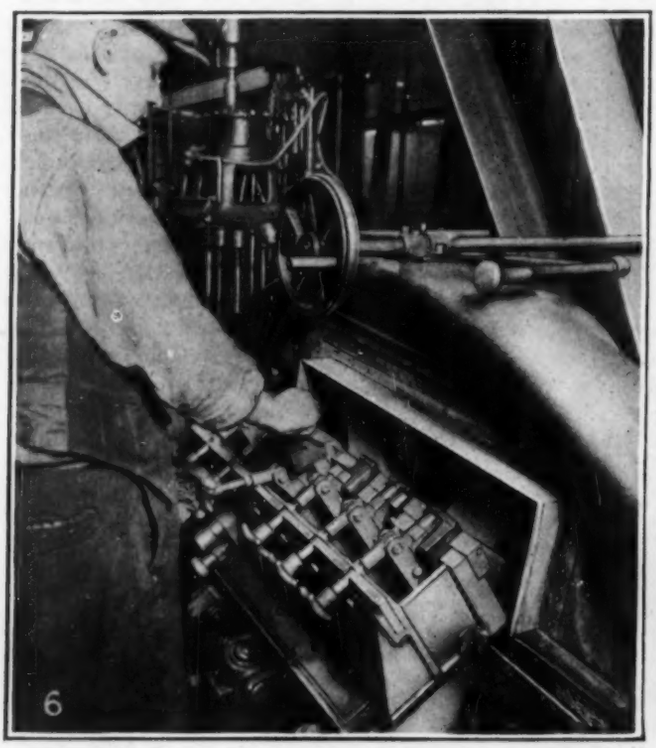
Automotive Production











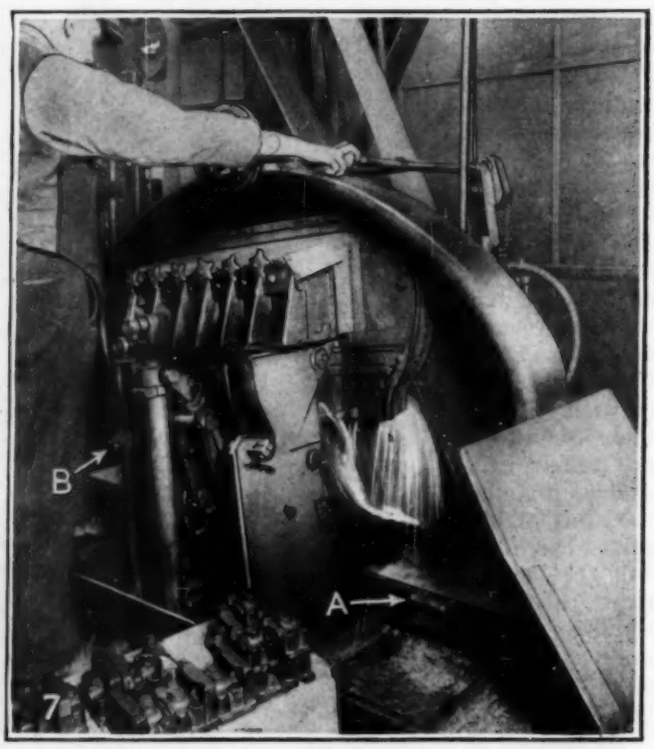


Fig. 2—Exhaust manifolds ground. Fig. 3—Locking work in fixture. Fig. 4—Work in place for grinding. Fig. 5—Flywheel housing, ground. Fig. 6—Multiple grinding. Fig. 7—Discharge of coolant.

Automotive Production

in grinding. A pump circulates the fluid through the wheel spindle or through the holding fixture, and slush pans are provided at the side. Positive oiling devices and large oil reservoirs provide a generous supply of oil, and care has been taken to protect all moving parts from entry of water or grit.

The work is loaded into the fixture, which is mounted on the work table. The operator starts the machine by pushing the control handle, which shifts the auxiliary belt and starts the feed cam and the oscillating mechanism of the trunnion. The work table then raises to the operating position, and the wheel housing is driven forward by the cam to the determined position, where it remains during several oscillations of the work table. This grinding interval is sufficient to allow for any unevenness in the surface of the work. The cam finally raises the follower, and drops the work table to the unloading position, at the same time automatically shifting the auxiliary belt.

The set-up and operation features of a typical automotive production job are shown in Figs. 2, 3, and 4. The work, which consists of the exhaust manifolds of the Pontiac car, is shown in Fig. 2. The manifold is of cast iron having a length of 24 in. The tolerance for the finished work is —0.005 in. Fig. 3 shows the workman placing the piece in position in the fixture, and Fig. 4 shows the work ready in the grinding position. An Eagle 24-M grinding wheel was used with soda water coolant. The production was 40 per hour.

In Fig. 5 is illustrated another job done on the Osterholm grinder. It is an automobile flywheel housing with grinding limits of from — 0.005 to +0.005 in. A carbolon grade R, 16 grain, wheel was used at a speed of 900 r.p.m., giving a production of 45 pieces per hour.

Grinding Crankshaft Bearings

The operation of loading a fixture preparatory to grinding automobile crankshaft bearings is shown in Fig. 6. The fixture is made to hold six of the bearings at a time, and when in the grinding position is completely encased by a metal shield to prevent any splash of the coolant. Fig. 7 shows the work table in grinding position with the entire discharge of liquid flowing off at the bottom into pans *A* and *B*. For this operation a weak solution of soda water was used, and the grinding was done with a Norton 16-M chrystolon wheel. The cast-iron pieces to be ground had a length of 4⅛ in., and an outside diameter of 3¼ in. The work was held to grinding limits of ±0.010 in. A production of 240 pieces per hour was attained. A feature claimed for the Osterholm surface grinder is the possibility of removing large quantities of metal at high speed without distortion from excessive heating.

A curtain is bolted to an aluminum frame, and oscillates with the work table to prevent the splash of the coolant when grinding on an open fixture. Dressing of the wheel is provided for by a dresser conveniently located in each fixture so that the operator can dress the wheel with relation to the work and with a minimum loss of time. The abrasive wheel is mounted into a steel draw-in chuck, and the wear of the abrasive is taken up by the adjustment of a calibrated hand wheel.

In case that the work becomes jammed or wrongly placed in the fixture, injury to the machine or wheel is prevented by the cushion action of a coil spring at the base of the cam follower arm. The machine and operator are further protected by an emergency stop lever within easy reach of the operator. A thrust on this lever will bring the machine to a stand at any point in its cycle.

Rejuvenating an Old Cylinder Grinder

By E. L. Mills

THIS tale is about a second-hand cylinder grinder of early vintage. It was purchased "sight unseen," as the boys say when they swap knives, but guaranteed to be in good condition—a dangerous way to buy any tool; a crime, for a tool for such fussy work as internal grinding.

When we began to use the grinder, it produced good looking holes. They seemed to be reasonably round when measured across and up and down, with the cylinder in place on the angle plate. A third measurement showed a bulge, or bay window, at about "10 o'clock," as one faced the cylinder. The bulge amounted to from 0.001 to 0.0015 in., depending upon how lightly the final cuts were taken, and it covered a strip about 2 in. wide in a 4-in. cylinder.

A Permanent Cure

The cause proved to be a slight flattening of the outer eccentric-spindle sleeve in the journal, which multiplied the error through the 16-in. wheel extension. A careful regrinding of the sleeve journals and a refitting of the bearings cured that trouble permanently and gave commercially round and parallel holes.

We had cylinders worn taper from 0.020 to 0.040 in., and any attempt to hurry the grinding usually meant a hot bearing near the wheel, that took hours to get back into adjustment. So during a dull spell we made a spindle that would stand the load and thrust. This spindle has been in constant use for two years with only one slight addition, and very little adjustment. The addition is the felt washer near the outer end of the extension to prevent loss of oil and the danger of bearings going dry. Some oil worked out while running, and also when the machine was shut down the oil would gradually get away. The washer stopped this leak.

The engineering department of the Timken Bearing Co., Toledo, Ohio, guaranteed the result of its bearings for this work and for speeds very much higher than we proposed using. The highest was 6,500 r.p.m. for the smallest wheel that we could use on this machine, and the size of bearing suggested came within the limits of inside and outside diameters possible in the extension and on the spindle.

These bearings were used only on the wheel end of the spindle, as it was not possible to get them into the driving end and keep the pulleys in line. The double ball bearing used, however, on that end has proved entirely satisfactory, as it is not so necessary to keep out

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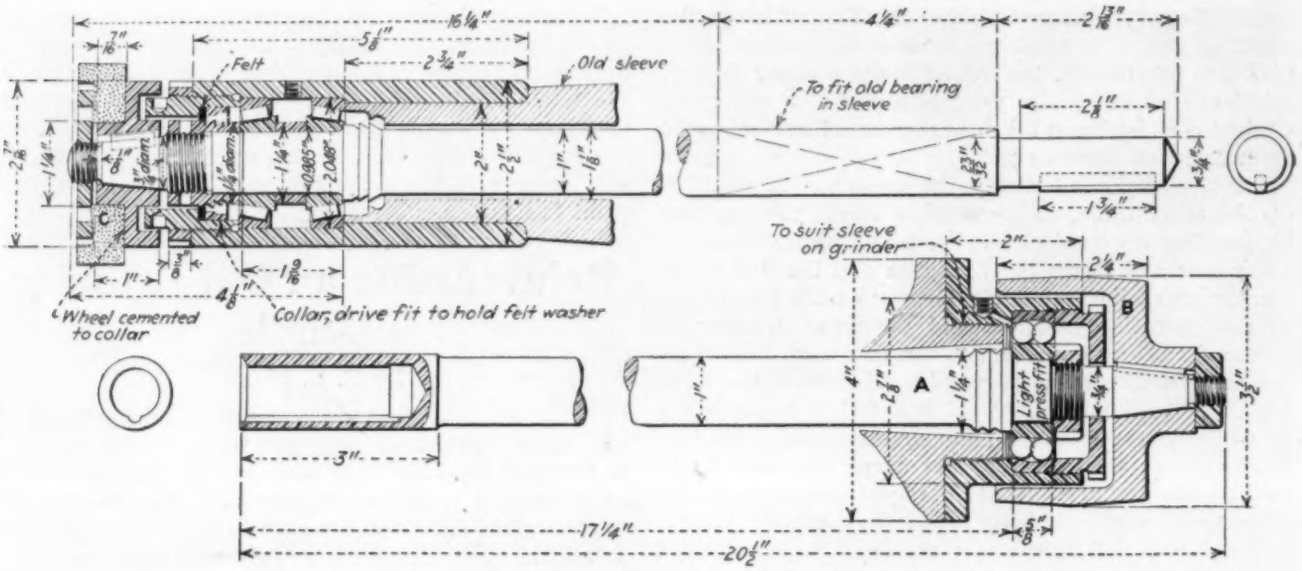


Spindle with new bearings

all lost motion. The old extension was cut off and a steel sleeve shrunk on, to increase its diameter enough to make room for the new bearings and the adjusting nut.

The thread on the rear end of the spindle sleeve, which previously had been used by the adjusting nut on the old tapered bearing, was used to attach the housing in which the double ball bearing was mounted. This change is clearly shown at *A* in the illustration. The old tapered bearing, at the inner end of the wheel extension, is used to support the spindle near the point where the slip joint was arranged to take care of any expansion due to heat.

There is a reason for the round keyway in the rear portion of this shaft and the corresponding shape of the key in the rear end of the wheel shaft. These two pieces of spindle were made from discarded automobile axles and were very hard and tough. It was found impossible to cut this keyway with the means available so that a plug was turned up from the same material with a small groove in one side, where the keyway was to be, and the key seat drilled.

It will be noted that both the pulley *B* and the wheel *C* are held on their respective shafts by means of a tapered fit, key and nut. Wheel collars of different sizes are provided, all reamed to the same taper and keyseated. About a teaspoonful of gum shellac is distributed on the collar, which is heated by any convenient means, and as soon as it melts, the wheel is laid on the collar, weighted and allowed to cool.

We found this method of handling our wheels, where frequent change of size is necessary, a great convenience. The nut is removed and the wheel collar pinched on the non-sticking taper of 2½ in per ft. The new wheel needs only touching with the diamond to make it true. Our wheels range from 2½ to 8 in. in diameter, not many of the larger ones being used. From 4 in. down, the wheels stay with the collar until they are reduced to the collar size.

The driving pulleys are quickly changed, so that the proper speed is given the wheel whether it be large or small. On the larger wheels, the collar provides a simple way of putting the unit in balance. A dovetail groove is turned in the back face on the collar, near its outer edge. With the wheel on a balancing arbor, it takes but a few minutes to drive enough lead into this groove to balance the wheel and collar. The success of this experiment, using Timken bearings for a spindle of this kind, where freedom without shake is absolutely essential, was very gratifying to us. There may be thousands of bearings in various machines that might be improved by a bearing of this kind.

The other day, a young "sales engineer" breezed into a small shop with a line of drills which he wanted to introduce, "just to show what a really *good* drill could do." The apprentice boy, who was busily engaged in wiping the oil and chips from the table of a Becker vertical milling machine, volunteered to find the "old man."

The old man, being duly found, listened to the seductive tale of the young engineer but shook his head sadly. He said he didn't use many drills; the kind of drill that he had always used suited him pretty well.

The young man cast a roving eye over the equipment, which included a two-spindle sensitive and a standard type of back-geared drill press, both in plain sight, and, coming back to the Becker miller, which happened to have a drill chuck and drill in the spindle, said: "This is the only drill press you have, I see. Pretty old, but no doubt serviceable for your limited needs. Just let me put a drill in it and show you how quickly we can go through a chunk of steel."

But the old man was not to be persuaded and the salesman finally departed; followed by the eye of the astonished apprentice. "Gee! boss," said the kid, "it's lucky I didn't leave the wipin' cloth on the table of this here miller 'er he'd 'a thought it was a sewin' machine."

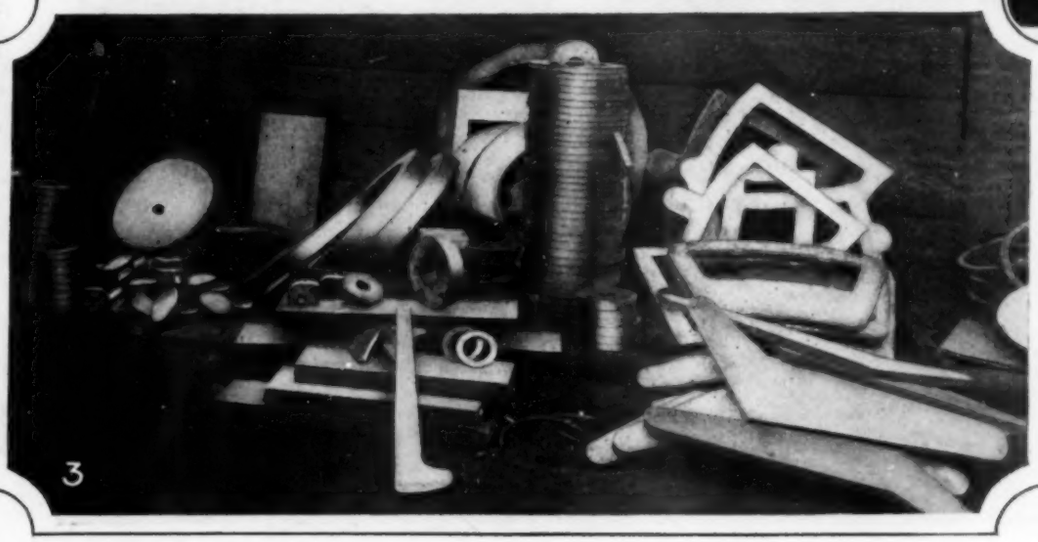
Metal Cutting with Oxyilluminating Gas

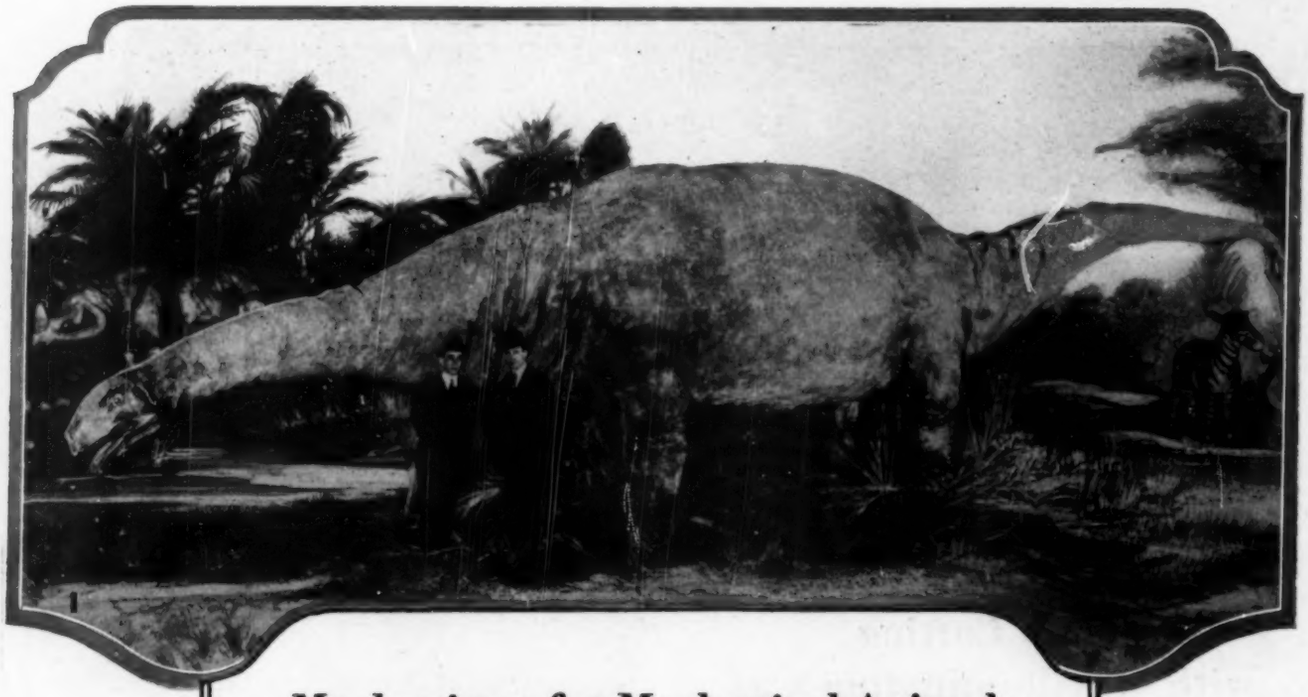
Illuminating gas, in combination with oxygen, has replaced acetylene, hydrogen and other fuel gases for metal cutting in the Schenectady plant of the General Electric Co. A special torch, developed for oxyilluminating gas, is now being used for cutting risers from steel castings. It is used also for cutting intricate shapes from steel plate.

For torch cutting, illuminating gas has been found cheaper than either hydrogen or acetylene, while the speed of cutting is about the same. Its properties permit its use in a torch equipped with a superheater, thus effecting a saving in the amount of oxygen required.

1—Cutting risers from steel castings
2—Cutting a 15-in. nickel-steel riser
3—Samples of work done on a cutting machine.

Photographs by courtesy of the General Electric Co.





Mechanisms for Mechanical Animals

Fig. 1—Side view of the 47-ft. Dinosaur

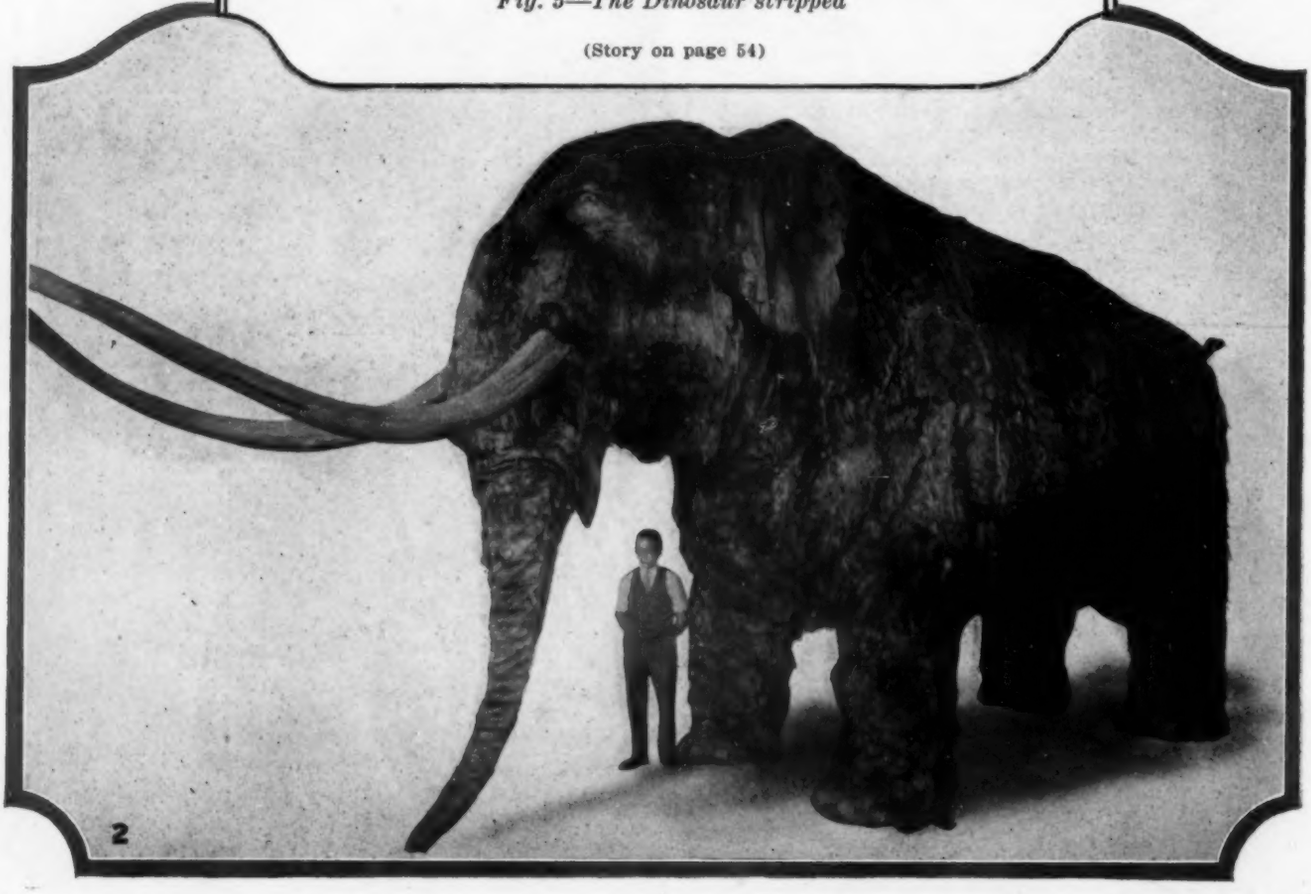
Fig. 2—The Mammoth, 28 ft. long and 14 ft. high

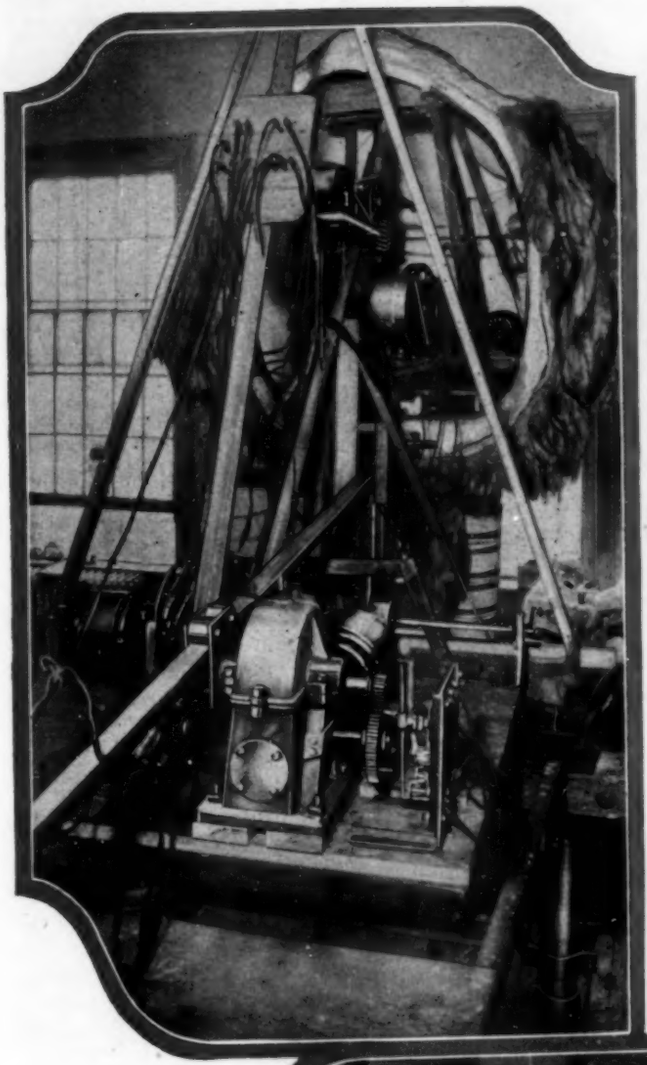
Fig. 3—Shoulder and head mechanisms of the Mammoth

Fig. 4—Left-hand side of the Mammoth's head

Fig. 5—The Dinosaur stripped

(Story on page 54)





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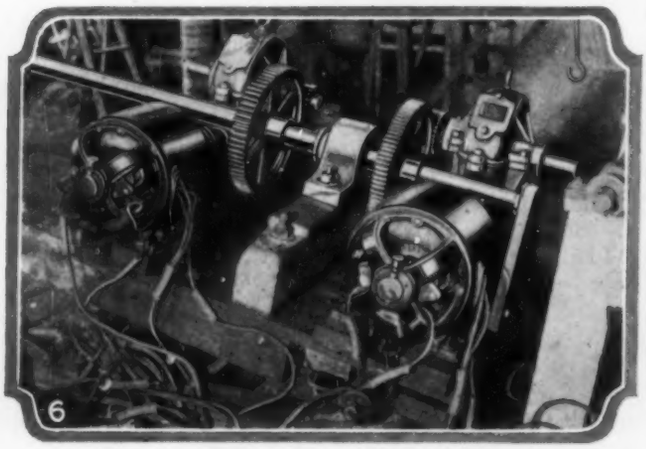

Fig. 6—The Dinosaur's neck "muscles"

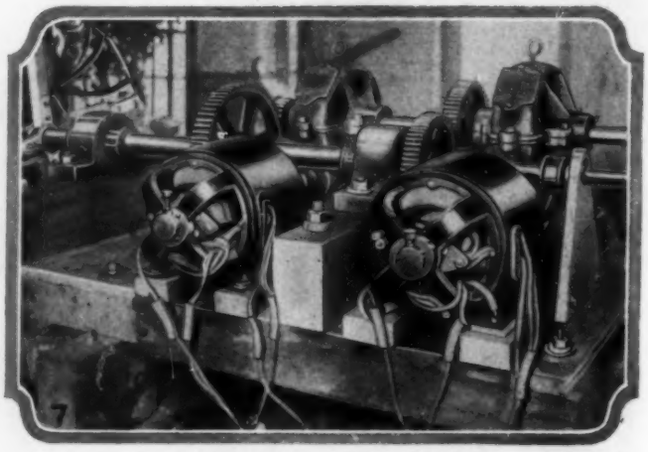

Fig. 7—Mechanism for swinging the Dinosaur's tail

Mechanisms for Mechanical Animals

THE mammoth and the "amphibious dinosaur brontosaurus" shown in Figs. 1 to 7, were built by Messmore & Damon, Inc., 404 West 27th St., New York, N. Y., after skeletons in the American Museum of Natural History. Their mechanical movements are all controlled by means of Star electric motors and Foote Bros. gear reducers.

In Fig. 1 is shown a side view of the dinosaur which is 47 ft. long and 9½ ft. high. Ten electric motors and gear reducers operate the mechanisms. Fig. 2 is a side view of the mammoth, standing 14 ft. high, 10 ft. wide and 28 ft. long.

The long rack in the center of Fig. 3, operated by means of a ½-hp. motor, raises the head. The head is pivoted by means of the reducing unit at the top of the illustration while the one immediately below it raises the trunk. The head and shoulders constitute a single unit supported on the platform shown in Fig. 3. This platform is operated on rollers from side to side through double reduction from the motor to the left of the illustration. A small motor in the head at the right oscillates the eyeballs.

In Fig. 4 can be seen a large pulley carrying the rope for lifting the trunk; this pulley is crank-operated as can be seen by referring to Fig. 3. The same reducing unit carries a separate pair of gears for operating the ears of the mammoth. Separate units are used for raising the skin over the feet, for expanding the sides and stomach to give the appearance of breathing, and for operating the tail.

A stripped view of the dinosaur is shown in Fig. 5. Counterbalances on the arms at the center of the body carry the weight of the entire neck.

As can be seen in Fig. 6, the motors swinging the neck operate the shaft through double reduction. The motors are connected by flexible couplings. In order to make the movement of the long neck and of the tail more realistic, a double twist is given to them. The motor to the left drives the outer shaft which swings the entire neck. The reducing unit to the right drives a flexible shaft within the main shaft and operates the outer half of the neck only.

The gear reducers shown in Fig. 7 perform a similar function to those in Fig. 6, in swinging the tail of the dinosaur. This animal, like the mammoth, is made to breathe, to open and close his mouth and eyes and to "lift" his feet. The two animals described represent the more complicated individuals in a mechanical zoo, that is on exhibition at "The World a Million Years Ago," Surf Ave. and 12th St., Coney Island, N. Y.

When the Big Boss "Bosses"

By Loring Roper

When things get goin' "limpy"
An' the work aint comin' through,
When the men get sort o' grouchy
As they sometimes seem to do,
When the foreman's kinder worried
And machines drop out of biz—
When each man is sort of dreading
Being fired—or "getting his,"

Then's the time the Big Boss better
Ask himself a thing or two—
Answer straight his every question—
Own up when the things are true.

An' quite frequent he'll discover
That the things that make work lag
Can be traced back to his office—
That's the start of many a snag.
'Stead of leading—he's been *bossin'*—
Razzing foremen—hard an' raw
They get peeved and pass it downward—
That's the human nature law.

An' the men get sour an' "edgy,"
Everybody's full of fight,
Just the Boss can stop the trouble,
He must set his methods right.

Removing Buckles and Dents from Sheet Metal

By E. Andrews
Manchester, England

Author discusses tools and methods used in repairing damaged sheet metal parts —How to make buckled plates lay flat

AFTER perusing the article under the title given above, which was published on page 278, Vol. 63, of the *American Machinist*, I have since thought that a few further notes, with the aid of sketches illustrating the practicability of removing dents from metallic objects and flattening buckled or distorted sheet metal plates, may be of interest to readers employed in various branches of engineering.

In the article referred to, it was mentioned that little information had previously been published on the art of smoothing, straightening out and removing dents from sheet metal. Probably this lack of information is due to the impression that the craft is one that can be acquired only by actual experience. It is true that experience is necessary, but it may be safely said that a careful study of the principles here outlined, together with some practice, will soon enable the average worker to become fairly proficient, so that typically damaged sheet metal objects can be straightened out and made to appear practically as new. Of course, readers interested in this modern craft should also digest the information imparted in the previous article.

In straightening out the dents on automobile and other curved sheet metal work, only a few inexpensive

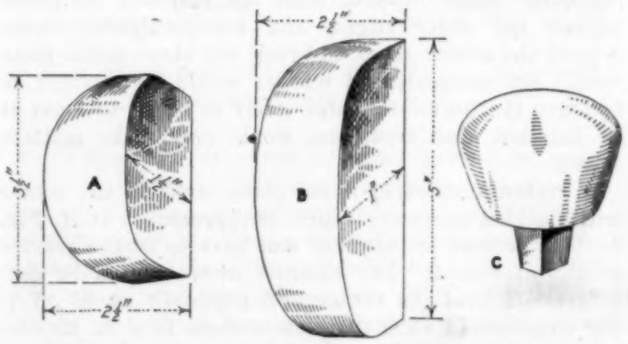

Fig. 1—Iron, or steel, dolly blocks used in straightening out dents on curved surfaces

tools are required. Among the most useful will be found the iron or steel dolly-blocks illustrated at *A* and *B* in Fig. 1. These tools are made in different sizes and radii and are shaped to fit the palm of the hand. Both of the blocks illustrated have beveled edges and sharp edges, and their peculiar shapes make them adaptable for work where an ordinary iron mandrel, or stake, could not be used satisfactorily. The dimensions given are average ones. The tool shown at *C* is generally used in a bench-mandrel stake. In Fig. 2 a sheet metal raising or hollowing hammer is shown at D_1 and a wood bossing mallet (generally known as a plumber's bossing mallet) is illustrated at *E*. Both of these tools are used to force the bumps, or dents, out. A smoothing or finishing hammer, *F*, is used extensively in all kinds of work.

Repairing Automobile Fenders

The writer had charge of the repairing of all the sheet metal work on over 600 motor vehicles, where the domed, or compound curvature type most frequently required attention. Once the mudguard was off the vehicle it was a comparatively easy job to straighten out the dents or to otherwise repair it.

To illustrate a typical repair of removing the dents on a domed-shaped automobile fender, the following is given: First, smooth the bumps, or dents, as far as possible with a suitable hammer or wooden mallet, preferably on a hardwood concave block. After the dents have been straightened out as well as possible the article can be smoothed up by placing it on the iron blocks of different radii (the one that fits the mudguard curvature best should be used), and hammering over and around the dented area. Careful, light hammering will restore it to its original shape.

Sometimes the dents are smoothed, but still show a few scars caused by the hammer face not striking the mudguard parallel to the metal surface, or by the dolly-block not being properly held to absorb the blows. In such cases as commercial motor vehicles, these slight defects would not be objectionable. In the case of a high-class automobile, however, where it is necessary to secure a perfectly smooth surface so as to give the vehicle a good appearance, it is often necessary to go over the outside with a smooth file. Always file in one direction, and never cross previous strokes. File down on the scars until by rubbing your open hand on where the dents were, the fender feels approximately smooth. Then wrap a piece of emery cloth around a suitable piece of wood and function as before in one direction only.

The above method applies to the removal of dents in the center or at other get-at-able parts of auto fenders or similar compound curvature sheet metal work. But should a damaged fender be dented on the edge close over the rim, which is the stiffening reinforcement under the edge, and it is impossible to remove the dents with the tools here described, a good method is to fill up the defects with solder (in some cases, it may be per-

haps preferable to fill up the defects by welding methods) and to smooth the metal surface with a file and emery cloth as described above.

An interesting and a generally effective method of straightening out dents from sheet metal articles such as automobile radiator water tanks, is first to fill the radiator with water and then apply a few pounds air pressure through a tube from an ordinary pneumatic tire pump after the inlet and overflow fittings have been properly plugged. Then with a piece of perfectly smooth wood, tap lightly around the edges of the dent, and the depression will be forced outward. Care should be taken that the air pressure applied is not so great as to involve a protrusion in some other part of the radiator. The latter is mentioned in case compressed air may be used.

Sometimes a sharp dent or V-shaped indentation may have to be dealt with, where the sheet metal has just escaped perforation. To deliver a sharp hammer blow directly on this type of a dent, would probably do more harm than good. In this case it is advisable to first anneal the sheet metal in the immediate vicinity of the dent, since the force of the blow that caused the indention hardened the metal at that point. When this has been properly done (as indicated in the previous article) the dent may be straightened out without the danger of fracture.

In addition to the tools and methods described above for the straightening out of dents from sheet metal, it may be of interest to mention at this point that the Fox Machine Co., Jackson, Mich., has put on the market a straightening press which should prove of great value as an adjunct to an up-to-date "straightening shop." An interesting description of this modern machine appeared on page 80, Vol. 62, of this journal.

To an inexperienced mechanic the art of flattening or levelling buckled, distorted, and badly damaged sheet metal plates having large plain surfaces, such as the

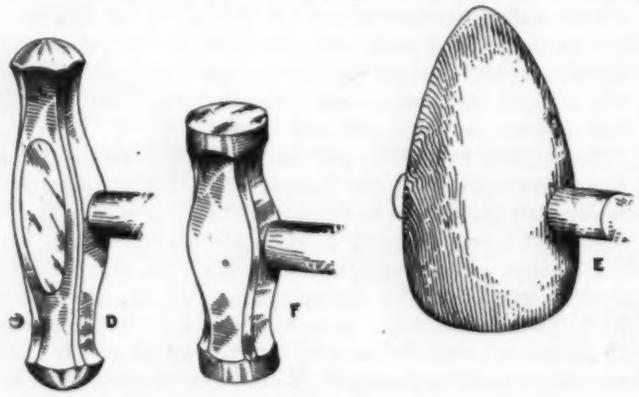

Fig. 2—Types of hammers used in working with dolly blocks

side of a business automobile, presents one of the most difficult jobs it is possible to have. It is obvious that the method of treatment will vary according to the character of the metal to be dealt with; for example, aluminum will not withstand the treatment that iron or steel may be subjected to, and in consequence, many light blows are preferable to a few heavy ones. With regard to the alteration of form caused by hammering, every piece of sheet metal has, of course, a particular shape, which depends on the fact that its constituent molecules have taken a definite relative position. When, by hammering, the position of some of these molecules is altered, it follows that the form of the sheet metal plate or panelling is altered likewise. Practical experience in the fabrication of sheet metals shows that every blow of a hammer is capable of fulfilling three functions, namely, stretching, thinning and hardening.

Before commencing to flatten or level a buckled sheet or plate, it will be helpful for the worker to determine first what gave rise to the buckled condition, and then

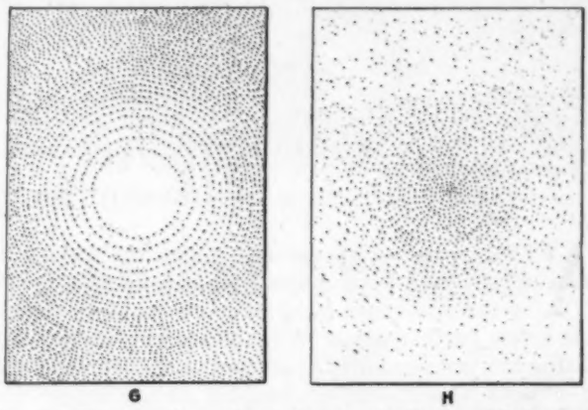

Fig. 3—Hammering chart for typically buckled plates

to deliver the hammer blows accordingly. With the aid of the diagrams which are presented, it may be well to briefly describe at this point a few examples of buckled sheet metal. First assume that the metal paneling or plate, shown at *G*, Fig. 3, has a buckle or bulge in the center, which indicates that there is too much area, or metal, in the central portion relative to the outer portion. The buckle, or bulge, is consequently restricted and cannot, therefore, spread itself out to lie in the same plane as that occupied by the outer portion. To flatten a sheet metal plate all strain must be removed, so that one part of the surface shall not be pulling against another. To do this all the tightened parts should be carefully hammered. The dotted lines upon the diagram indicate approximately the places at which the hammer blows should be delivered, working from the outer edges inward, with the majority of blows around the outer edges, and fewer, lighter blows toward the center so as to bring the sheet metal plate level. An inexperienced worker would be tempted to hammer the buckle or bulge itself in order to make it lie flat, but such treatment would only make matters worse.

A rectangular sheet metal plate, tight in the center with buckled and wavy edges, is represented at *H*, Fig. 3. The process in this case will have to be the reverse of the aforesaid. The hammer blows should be concentrated about the center and gradually eased off to the outer edges until the plate will lie level of its own accord. It should be borne in mind that blows delivered on the edges would tend to intensify the trouble by making the edges in this case more buckled.

In conclusion, it should be emphasized that buckles and distortions in sheet metal plates can only be corrected by judiciously hammering the area, or surfaces, which are "tight." All strains and stresses must be removed. The mechanic who is fabricating the work should have a clear idea of what blows are necessary, and exactly where they are required before delivering them. A blow delivered in the wrong place may necessitate at least one dozen blows to correct it.

The Design of Gear Tooth Forms

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Comparison of the 14½-deg. basic-rack, variable-center gear system with conventional gear tooth forms—Development of the range-cutter, proportional-center system

WE WILL make a brief analysis of the variable-center system, discussed in the previous article, for the purpose of comparing it with the conventional systems. The forms of the 12-, 15-, 18- and 21-tooth gears of this system are shown in Fig. 73. Particular attention is drawn to the strong tooth forms that result from the avoidance of undercutting.

Table XIII shows the duration of contact, in terms

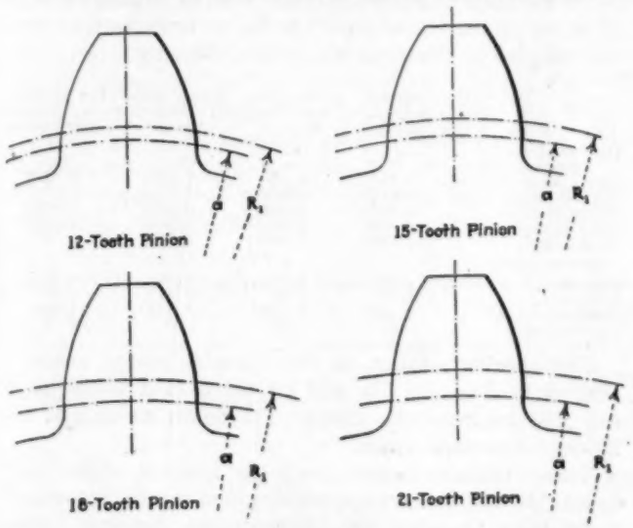


Fig. 73—Strong tooth forms of the 14½-deg. basic-rack, variable-center system

of tooth intervals, between the combinations of gears in this system with small tooth numbers.

As a direct comparison with gears of other systems, we will examine the sliding conditions between various combinations in this series. As a first example, we will consider a pair of 12-tooth pinions of 1 D.P. meshing together. For these, we get the following values, which are tabulated with the values for similar pinions of the 20-deg. stub-tooth system:

	20 Deg. Stub Tooth System	14½-Deg. Basic Rack Variable-Center System
Number of teeth	12	12
Max. radius of curvature of active profile	3.8014 in.	4.4122 in.
Min. radius of curvature of active profile	0.3028 in.	1.2073 in.
Active profile above pitch line	0.8000 in.	0.7976 in.
Active profile below pitch line	0.3538 in.	0.5190 in.
Total height of active profile	1.1538 in.	1.3166 in.
Specific sliding, addendum	+ 0.92	+ 0.72
Specific sliding, dedendum	—11.55	—2.65
Duration of contact, tooth intervals	1.185	1.052
Pressure angle	20°	25°–49′

The seventeenth article. The eighteenth will appear in an early issue.

The specific sliding on the variable-center gears is plotted in Fig. 74. This table of comparison shows a shortened duration of contact for the variable-center gears, but larger radii of curvature, longer active profiles, and much more favorable sliding conditions than on the 20-deg. stub-tooth gears. The additional contact on the stub-tooth gears has been gained at the expense of very much more sensitive tooth profiles. Of the two, much less difficulty would be incurred in producing satisfactory gears to the variable-center system than to the stub-tooth system. Neither of these two pairs are suitable for the quiet transmission of any amount of power, because the contact is too short in both cases.

As a second example, we will compare these same 12-tooth pinions running with 30-tooth gears, 1 D.P. For these we have the following values:

	20-Deg. Stub Tooth System	14½-Deg. Basic Rack Variable-Center System
Number of teeth in pinion	12	12
Max. radius of curvature of active profile	3.8014 in.	4.7416 in.
Min. radius of curvature of active profile	0.1682 in.	0.7086 in.
Active profile above pitch line	0.8000 in.	1.2943 in.
Active profile below pitch line	0.3593 in.	0.3522 in.
Total height of active profile	1.1593 in.	1.6465 in.
Specific sliding, addendum	+ 0.64	+ 0.75
Specific sliding, dedendum	—15.68	—2.90
Duration of contact, tooth invervals	1.230	1.325
Pressure angle	20°	20°–34′
Number of teeth in gear	30	30
Max. radius of curvature of active profile	7.0142 in.	6.9196 in.
Min. radius of curvature of active profile	3.3810 in.	2.8866 in.
Active profile above pitch line	0.7441 in.	0.5763 in.
Active profile below pitch line	0.5048 in.	0.7039 in.
Total height of active profile	1.2489 in.	1.2802 in.
Specific sliding, addendum	+ 0.94	+ 0.74
Specific sliding, dedendum	—1.81	—3.10

The specific sliding on the variable-center gears is plotted in Fig. 75. This table of comparison shows

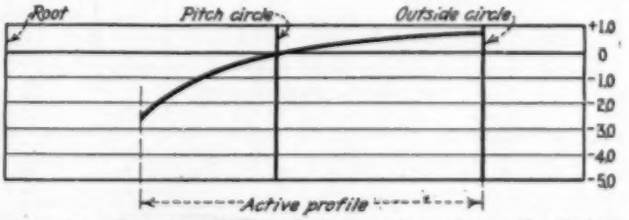


Fig. 74—Specific sliding between two 12-tooth pinions of the 14½-deg. variable-center system

larger radii of curvature for the pinion, longer active profiles, nearly balanced and more favorable sliding conditions, and longer contact for the variable-center gears. The pressure angles are practically the same on both pairs. This great difference in the nature of the tooth action between them is due to the fact that the

tooth design of one pair is governed by the base circles while that of the conventional pair is governed by the pitch circles.

The next example will be a pair of 14-tooth, 1-D.P. pinions that will be compared with similar pinions of the 20-deg., full-depth tooth system. For these we have the following values:

	20 Deg. Full-Depth Tooth System	14½-Deg. Basic Rack Variable-Center System
Number of teeth	14	14
Max. radius of curvature of active profile	4.4828 in.	4.8024 in.
Min. radius of curvature of active profile	0.3054 in.	1.3263 in.
Active profile above pitch line	0.9614 in.	0.8685 in.
Active profile below pitch line	0.4150 in.	0.5314 in.
Total height of active profile	1.3764 in.	1.3999 in.
Specific sliding, addendum	+ 0.93	+0.72
Specific sliding, dedendum	—13.67	—2.62
Duration of contact, tooth intervals	1.415	1.142
Pressure angle	20°	24°–20′

The specific sliding on the variable-center gears is plotted in Fig. 76. The contact on the 20-deg. full-depth tooth gears is very much greater than on the variable-center gears, but the additional contact is obtained at the expense of very sensitive and troublesome tooth profiles.

The next example will compare these same 14-tooth pinions when meshing with 30-tooth gears, 1 D.P. For these we have the following values:

	20-Deg. Full-Depth Tooth System	14½-Deg. Basic Rack Variable-Center System
Number of teeth in pinion	14	14
Max. radius of curvature of active profile	4.5532 in.	5.0779 in.
Min. radius of curvature of active profile	0.3054 in.	0.8525 in.
Active profile above pitch line	1.0000 in.	1.2502 in.
Active profile below pitch line	0.4150 in.	0.3878 in.
Total height of active profile	1.4150 in.	1.6380 in.
Specific sliding, addendum	+ 0.69	+0.74
Specific sliding, dedendum	—10.03	—2.41
Duration of contact, tooth intervals	1.347	1.389
Pressure angle	20°	20°–8′
Number of teeth in gear	30	30
Max. radius of curvature of active profile	7.2190 in.	6.9562 in.
Min. radius of curvature of active profile	2.9712 in.	2.7308 in.
Active profile above pitch line	0.8365 in.	0.5921 in.
Active profile below pitch line	0.5949 in.	0.6909 in.
Total height of active profile	1.4314 in.	1.2830 in.
Specific sliding, addendum	+0.91	+0.73
Specific sliding, dedendum	—2.28	—2.98

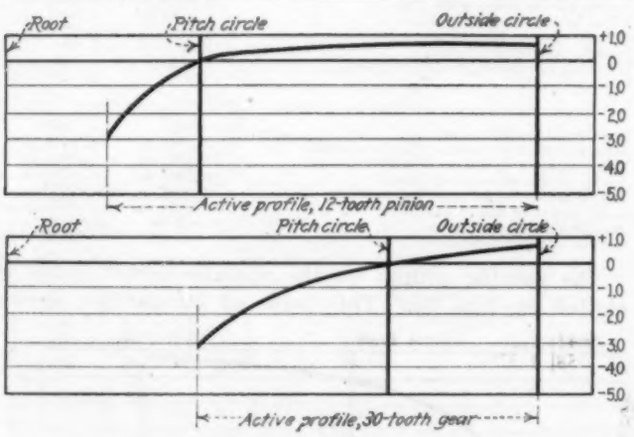


Fig. 75—Specific sliding between a 12-tooth pinion and a 30-tooth gear, 14½-deg. variable-center system

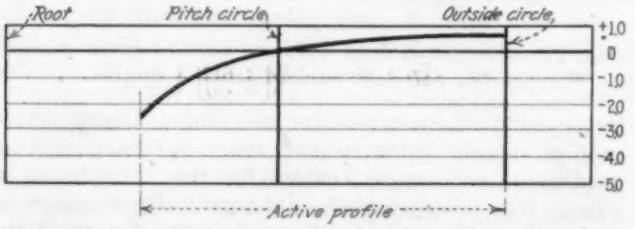


Fig. 76—Specific sliding between two 14-tooth pinions of the 14½-deg. variable-center system

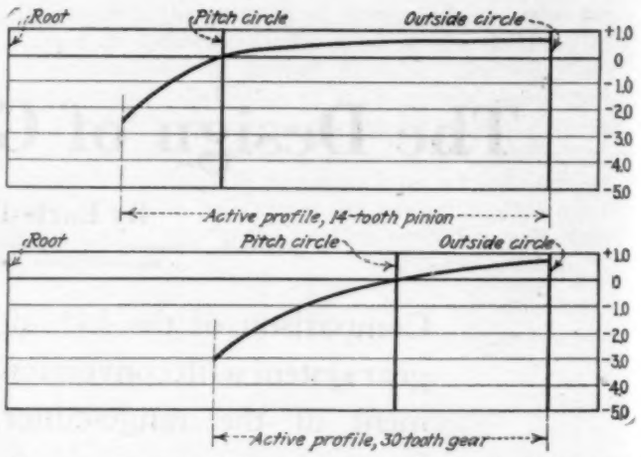


Fig. 77—Specific sliding between a 14-tooth pinion and a 30-tooth gear, 14½-deg. variable-center system

The specific sliding on the variable-center gears is plotted in Fig. 77. Here again, the sliding conditions are balanced, and much more favorable on the variable-center gears than on the others.

The next example will be a pair of 22-tooth, 1-D.P. gears meshing together. These will be compared with all three of the conventional tooth systems now in general use. For these we have the following:

	14½-Deg. Generated System	20-Deg. Full Depth Tooth System	20-Deg. Stub Tooth System	14½-Deg. Basic Rack, Variable-Center System
Number of teeth	22	22	22	22
Active profile	In.	In.	In.	In.
Max. radius curvature	4.7921	6.0954	5.6916	6.1244
Min. radius curvature	0.7163	1.4290	1.7328	1.6843
Above pitch line	0.6610	1.0000	0.8000	0.9422
Below pitch line	0.3263	0.5651	0.5192	0.5609
Total height	0.9873	1.5651	1.3192	1.5031
Specific sliding				
Addendum	+0.85	+0.76	+0.69	+0.72
Dedendum	—5.69	—3.26	—2.28	—2.63
Contact	1.340	1.580	1.307	1.462
Pressure angle	14½°	20°	20°	20°–8′

The specific sliding on the variable-center gears is plotted in Fig. 78. It will be noted that these gears are just between the 20-deg. full-depth tooth and the 20-deg. stub-tooth gears.

These variable-center gears in general show more favorable and balanced operating and production conditions than those of the conventional systems. With small tooth numbers, it is necessary to use higher pressure angles in order to obtain sufficient distance between the base circles to form effective gear tooth profiles. It is also necessary to vary the height of the addenda of mating gears of small tooth numbers to avoid sensitive and troublesome tooth profiles. As the numbers of teeth increase, the distance between the base circles becomes greater, so that lower pressure angles can be used effectively. When sufficient distance between the base circle exists, it is not essential to vary the addenda of mating gears, because the portion of the involute curve used for the tooth profiles has flattened out to such an extent that the possibility of obtaining sensitive profiles has disappeared. A system of variable-center gears for the smaller tooth numbers, such as has been described, where the teeth on each gear of the system has been designed to keep away from the base circle and sensitive parts of the involute curve, automatically obtains favorable contact conditions. It will be noted that the specific sliding on these variable-center gears remains nearly constant for all combinations. It will also be found that the strength of the

tooth forms is nearly constant throughout the whole range, the smaller tooth numbers being slightly stronger, if anything, than the larger tooth numbers. In other words, such a method of designing tooth forms results in a balanced design.

Although these variable-center gears can be readily used on all new construction, they cannot be used for replacement in existing mechanisms that are made to use gears designed for proportional center distances. A series of cutters could be made, however, so that these same general tooth designs could be used on such proportional center distances. There are several possible solutions to this problem. We will consider only the simplest.

In the variable-center system, the only restriction placed upon the tooth design was that all gears of the same nominal pitch must be generated from a single basic rack. We will now remove that restriction and impose a different one; to wit, that all gears of a given nominal pitch must operate at center distances that are directly proportional to the total number of teeth in the mating pair. In order to accomplish this and still retain effective tooth design, we must base this system on a series of basic racks of different pressure angles and tooth proportions instead of a single one. Such a system will be called the range-cutter, proportional-center system. For gears of 1 diametral pitch, the center distances will always be equal to one-half the sum of the tooth numbers of the meshing pair. As before, we will study only gears of 1 diametral pitch. The dimensions of gears of other pitches are determined by dividing the values for 1 diametral pitch by the diametral pitch employed.

Instead of having one basic rack for the gear system, and varying the center distances to obtain more effective gear-tooth design, we will now have a series of different basic racks and will maintain proportional, or standard, center distances. A study of the table of center distances and pressure angles for the variable

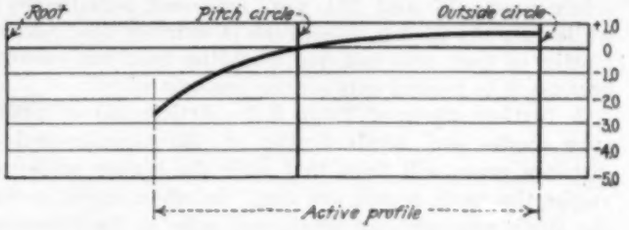


Fig. 78—Specific sliding between two 22-tooth pinions of the 14½-deg. variable-center system

center distance gear system given in the preceding article shows pressure angles ranging from 14½ deg. up to about 27½ deg. This variation must be divided into steps that will establish the pressure angles for the series of range cutters of basic rack form.

At the present time generating cutters, or hobs, of involute basic rack form with pressure angles of 14½ deg. and 20 deg. are extensively used. We will therefore retain both of these cutters in our proposed series of range cutters. The resulting system of gears will thus be an extension and improvement of existing systems; or rather, the co-ordination of the present systems into a single one, instead of an entirely new gear system.

The difference between 14½ deg. and 20 deg. is too

Table XIII—Duration of Contact Between Gears of the 14½-Deg. Basic-Rack, Variable-Center System in Terms of Tooth Intervals

No. of Teeth in Gear	Number of Teeth in Pinion															
	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
10	0.961															
11	0.981	1.010														
12	1.000	1.030	1.052													
13	1.019	1.049	1.072	1.097												
14	1.038	1.068	1.092	1.117	1.142											
15	1.056	1.087	1.112	1.137	1.162	1.184										
16	1.074	1.106	1.132	1.157	1.181	1.204	1.224									
17	1.092	1.125	1.151	1.176	1.200	1.223	1.244	1.266								
18	1.109	1.143	1.170	1.195	1.218	1.242	1.264	1.286	1.308							
19	1.126	1.160	1.188	1.213	1.236	1.261	1.283	1.305	1.327	1.347						
20	1.142	1.176	1.205	1.230	1.254	1.279	1.302	1.324	1.345	1.365	1.385					
21	1.156	1.191	1.220	1.246	1.271	1.296	1.320	1.341	1.362	1.383	1.404	1.424				
22	1.169	1.205	1.234	1.261	1.287	1.312	1.337	1.358	1.379	1.401	1.423	1.443	1.459			
23	1.181	1.218	1.247	1.275	1.302	1.327	1.353	1.374	1.395	1.418	1.441	1.461	1.480	1.498		
24	1.193	1.231	1.260	1.289	1.317	1.342	1.368	1.389	1.410	1.434	1.458	1.478	1.497	1.516	1.534	
25	1.204	1.243	1.272	1.302	1.331	1.356	1.382	1.403	1.424	1.449	1.474	1.494	1.513	1.532	1.550	1.567
26	1.214	1.254	1.283	1.314	1.344	1.369	1.395	1.416	1.437	1.463	1.489	1.510	1.530	1.550	1.569	1.584
27	1.224	1.264	1.294	1.326	1.356	1.381	1.407	1.428	1.449	1.476	1.503	1.525	1.546	1.567	1.587	1.600
28	1.233	1.273	1.304	1.337	1.367	1.393	1.419	1.440	1.460	1.488	1.516	1.539	1.560	1.581	1.601	1.615
29	1.243	1.283	1.315	1.348	1.378	1.405	1.431	1.451	1.471	1.500	1.528	1 551	1.572	1.593	1.613	1.630
30	1.252	1.292	1.325	1.358	1.389	1.417	1.442	1.462	1.482	1.511	1.540	1.563	1.584	1.605	1.625	1.644
31	1.261	1.301	1.335	1.368	1.399	1.428	1.453	1.474	1.495	1.524	1.553	1.576	1.598	1.620	1.640	1.660
32	1.270	1.310	1.344	1.378	1.409	1.439	1.464	1.486	1.508	1.537	1.566	1.589	1.612	1.635	1.655	1.674
33	1.279	1.319	1.353	1.387	1.419	1.449	1.475	1.498	1.521	1.550	1.579	1.602	1.626	1.649	1.670	1.688
34	1.288	1.328	1.362	1.396	1.429	1.459	1.488	1.510	1.534	1.563	1.592	1.615	1.639	1.663	1.684	1.702
35	1.297	1.337	1.371	1.405	1.438	1.469	1.499	1.522	1.546	1.575	1.604	1.627	1.651	1.676	1.697	1.716
36	1.306	1.346	1.380	1.414	1.447	1.479	1.509	1.534	1.558	1.587	1.616	1.639	1.663	1.688	1.710	1.730
37	1.315	1.355	1.389	1.423	1.456	1.489	1.519	1.545	1.570	1.598	1.628	1.652	1.674	1.700	1.723	1.734
38	1.323	1.364	1.398	1.432	1.465	1.499	1.529	1.556	1.582	1.610	1.640	1.664	1.688	1.712	1.735	1.757
39	1.331	1.373	1.407	1.441	1.474	1.509	1.539	1.567	1.594	1.622	1.651	1.676	1.700	1.724	1.747	1.769
40	1.339	1.381	1.416	1.450	1.483	1.519	1.549	1.578	1.606	1.634	1.662	1.688	1.712	1.736	1.759	1.781

large a step, so that we will introduce an intermediate pressure angle of 17 deg. We will also make the greatest pressure angle 25 deg. and introduce an intermediate one of 22½ deg. This gives us the following series of pressure angles: 14½, 17, 20, 22½ and 25 deg.; a total of five. Of these, 14½ and 20 deg. are now extensively used; 17 and 22½ deg. are used occasionally; while only the 25-deg. basic rack is entirely new. As a matter of fact, this last one would be used but seldom because it is needed only on the smallest pairs.

A further study of Table XII (Article 16) of pressure angles and tooth depths of the variable-center distance gears will show that with the higher pressure angles the tooth depths are less. In other words, when the tooth numbers are small, not only is the pressure angle increased in order to obtain a greater distance between the base circles, but the tooth depths are also reduced so that a sufficient distance between these base circles is obtained with a smaller increase in pressure angle than would otherwise be necessary. We will therefore make the basic racks of this series of the higher pressure angles with a lesser working depth. For the sake of simplicity, we will use a constant clearance of 0.200 in. The proportions of these basic racks will therefore be as follows:

Pressure angle, deg	25	22½	20	17	14½
Addendum, In.	0.800	0.900	1.000	1.000	1.000
Working depth, In.	1.600	1.800	2.000	2.000	2.000
Clearance, In.	0.200	0.200	0.200	0.200	0.200
Whole depth, In.	1.800	2.000	2.200	2.200	2.200

These basic racks are shown in Fig. 79. The nominal pitch line of these racks, or the place where the thickness of tooth and space are equal, will be in the middle of the working depth. At this point the thickness of both the tooth and the space of the basic rack of 1 diametral pitch are equal to 1.5708 inches.

The next step is to establish the range that each basic rack will cover. We will use the 14½-deg. basic rack for all gears where the smallest one in the pair has forty teeth or more. Referring to Table XII, Article 16, of pressure angles for the variable center distance gears, we will establish the following ranges for each of our basic racks:

14½-deg. basic rack cutter to generate all gears of 14½° pressure angle.
17-deg. basic rack cutter to generate gears from 14°-31′ to 17°-20′ pressure angle.
20-deg. basic rack cutter to generate gears from 17°-21′ to 20°-45′ pressure angle.
22½-deg. basic rack cutter to generate gears from 20°-46′ to 23°-15′ pressure angle.
25-deg. basic rack cutter to generate all gears over 23°-16′ pressure angle.

The next step is to determine the proportions of the addenda of mating gears. When the tooth numbers are equal, the addenda must also be equal. In all other cases, however, with pinions of less than forty teeth, the addendum of the smaller gear, or pinion should be longer than that of its mating gear in order to avoid sensitive tooth profiles and other unfavorable contact conditions. For example, the 10-tooth pinion of the variable-center gears when meshing with a 40-tooth gear has an addendum of 1.4823 in., while that of the mating gear is 0.4399 in. In this case, the addendum of the pinion is over three times as long as that of its mating gear. We will establish the maximum addendum for any pinion as three times that of its mating gear. The sum of the addenda of mating gears is always equal to the working depth, whence the maximum addendum of any pinion will be three-fourths of the working depth.

The next step is to establish the increments or differences in the addenda for successive combinations. On the variable center distance gears, this increment starts at about 0.040 in. between the 10/10 and 10/11 combinations, and reduces to about 0.013 in. between the 10/39 and 10/40 combinations. For the sake of simplicity, we will establish a constant increment of 0.020 in. until the pinion meshes with a 40-tooth gear, or until the addendum of the pinion reaches a maximum of three-quarteres of the working depth, after which the addendum of any pinion will remain constant.

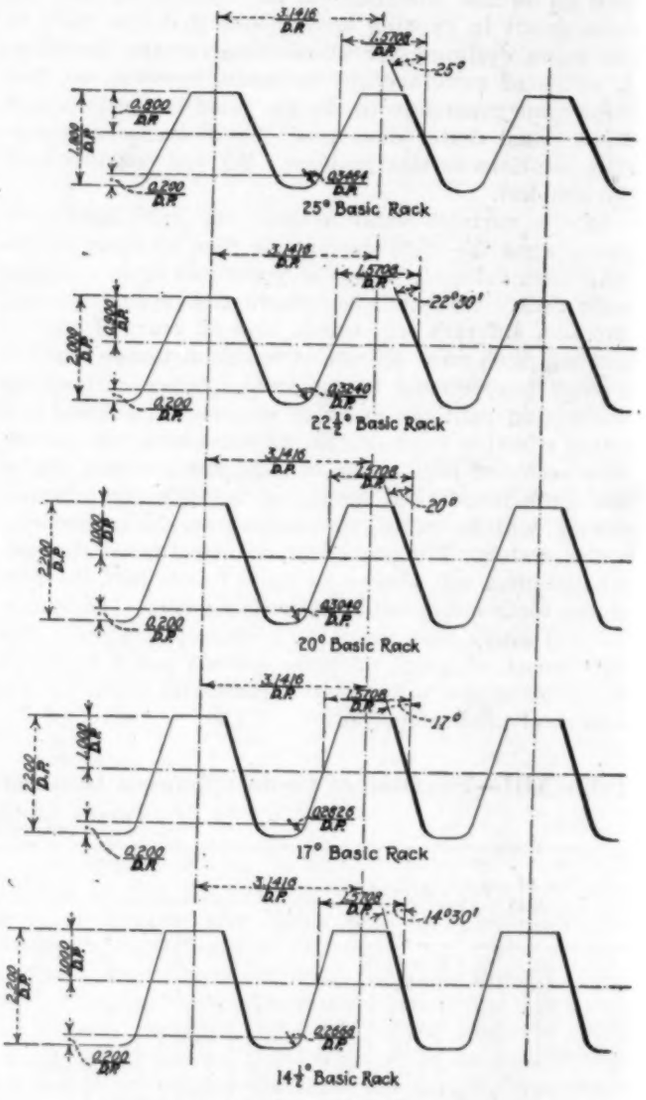


Fig. 79—Basic racks of the range-cutter, proportional-center system

The maximum correction of the addendum of any pinion will be reached when it meshes with a 40-tooth gear. When it meshes with larger gears it will have the same correction, and we will also use the same pressure angle, as when it meshes with a 40-tooth gear of this system.

"Burring" covers a multitude of operations on a route sheet. It usually means a man or a girl with a file taking off sharp corners and seems to be one of the hand operations that is hard to eliminate.

Solution of the Third Prize Problem Submitted by B. J. Stern

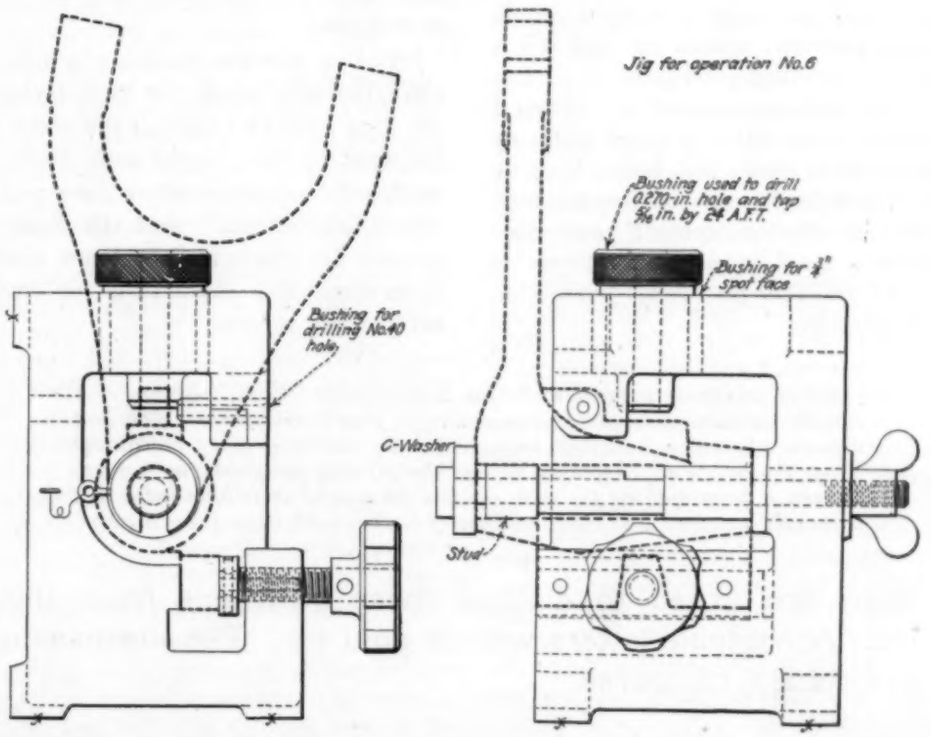
NEPTUNE METER CO.
Long Island City, N. Y.

The conditions of the problem and the winning solutions were published on pages 473, 474 and 475, Vol. 64, of the *American Machinist*

OPERATION SHEET

PART.....Shifting yoke
MATERIAL.....Nickel steel—S.A.E. No. 2315, drop forged
DEPTH OF CUT.....$\frac{1}{16}$ to $\frac{1}{4}$ in.
PRODUCTION.....1,000 lot: 15,000 yearly

Oper. No.	Description of Operation	Machine Tool	Feeds and Speeds	Floor to Floor Time
1	*a*. Spot center for 0.498-in. hole *b*. Drill $\frac{31}{64}$-in. hole *c*. Ream 0.498-in. hole *d*. Spot face one end of hole	Warner & Swasey No. 4 Universal Turret with two-jaw box chuck	*a*. Hand feed *b*. Feed, 0.01 in. per rev. *c*. Hand feed *d*. Feed, 0.031 in. per rev. Work speed, 450 r.p.m.	65 sec.
2	Grind yoke sides Special push-in fixture	Besly double-spindle, wet-wheel grinder	Hand feed Spindle speed, 1,200 r.p.m.	10 sec.
3	Gang mill rack-tooth slot—two fixtures, one loading, one milling. Arrange dogs on table for automatic cycle control	Cincinnati No. 4 Miller, Automatic	Feed, 0.031 in. per rev. Spindle speed, 45 r.p.m.	60 sec.
4	Gang mill top and sides of lug—same fixtures as operation 3, turned 90 deg.	Cincinnati No. 4 Miller, Automatic	Feed, 0.031 in. per rev. Spindle speed, 60 r.p.m.	75 sec.
5	Straddle mill yoke to 2.007-in. dimension—two fixtures, one loading, one milling. Arrange dogs on table for automatic cycle control	Cincinnati No. 4 Miller, Automatic	Feed, 0.031 in. per rev. Spindle speed, 75 r.p.m.	45 sec.
6	*a*. Drill 0.270-in. hole *b*. Spot face $\frac{3}{4}$-in. face *c*. Tap $\frac{9}{16}$-in. by 24 A.F.T. *d*. Drill No. 40 hole	Gang drill	*a*. 960 r.p.m., 0.007-in. feed *b*. 300 r.p.m., hand feed *c*. 200 r.p.m., hand feed *d*. 1,800 r.p.m., 0.007-in. feed Total time.....	25 sec. 280 sec.


Jig for operation No.6
Bushing used to drill 0.270-in. hole and tap 9/16 in. by 24 A.F.T.
Bushing for 3/4" spot face
Bushing for drilling No.40 hole
C-Washer
Stud

THE · FOREMAN'S · ROUND · TABLE

How Much Standby Equipment Is Necessary?

The following narrative is a "case" presentation of the topic. It has been written to involve some of the questions that arise in the average shop. For guidance in preparing discussion the questions at the foot of the page have been prepared

"WHAT'S the idea of asking for a new lathe for your department, Al?" asked the super as he met Al near the toolroom. "Haven't any new orders that I don't know about have you?"

"Guess not, Mr. White," said Al. "You generally know about new orders before I do. It isn't new orders, but the ones we already have that are bothering me just now."

"How come, Al?"

"Well, as I understand it, that big order for Johnson is mighty important. May mean more big orders if we come through on time. I've got one or two lathes that are not all they should be and I'm pushing every last one in the department to the limit. If one of my lathes should decide to quit it would put a crimp in my production and might delay that Johnson order along with the rest.

"The importance of that Johnson order and the fact that we ought to scrap a couple of my lathes anyhow, makes me feel it's a lot safer to buy another good lathe now than to wait 'til we get up against it. When I visited Detroit last fall I studied some of the big automobile shops and found they all had extra machines in case of breakdowns. Called 'em 'standby equipment' and considered them a good investment. Some of them figured on ten per cent production capacity for standby."

"Glad you've been thinking ahead, Al. It's a good sign in any foreman. And I get your point on that lathe requisition. I'll O.K. it today. But just what would you do if one of your lathes let go before the new one arrives? Can't you find some way to keep that Johnson work going in any case?"

"That's all provided for, Mr. White, but I didn't want to spring it until I knew I'd get the lathe. For it's only a makeshift at best. When I found how important the Johnson job really was I began scouting around for possible ways of handling that job. I've got a way planned to handle part of the job on the small boring mill in Jack's department if I have to. I could also do part of it on that heavy-duty drill with a few fixtures. But it's a lot cheaper to have a standby lathe and you can't get that any too quick to suit me."

"You've set me thinking a bit, Al, and I'm glad you asked for that lathe. You'll get it as soon as I can put the order through. I'll want to talk to you soon about standby equipment on some other jobs and I won't forget this, either." And the super went off toward his office, glad to know that he had a foreman who could plan for emergencies before they arrived.

What provision do you make for breakdowns? What percentage of standby equipment do you find necessary in your line of work? Have you definite plans for handling emergencies by utilizing other machines? What should Al do, assuming he had the standby equipment he wanted, to keep it from making the men careless because of their knowledge that a standby machine was ready in case of trouble with the regular one?

All foremen are urged to discuss these questions from their own experience. Acceptable letters will be paid for. The discussion is not limited to foremen, of course.

Discussion of Earlier Topics

Wants Suggestion Committee Appointed

SUGGESTIONS from the workmen in any but a very small shop can best be handled by a committee of three or five members, never more than the latter number. This committee may be made up entirely of men from the engineering department, but other beneficial results will be found if it is made up of foremen, as well as one or two "white collar" men. Better results, still, will come from re-appointing or changing the committee periodically, perhaps every six months.

The average shop man might never "get to it" to write out his suggestion and put it in a box, but he is free to pass it on to the foreman. The latter should give him full credit, and will do so if there is a regular suggestion committee. If the workman is allowed to waylay the superintendent without speaking to the foreman, there is bound to be a lot of "bad blood" in the shop before long. And who wants to be superintendent if 500 men have the privilege of coming around every time a half-baked idea presents itself? Actual experience with suggestion boxes has shown that only a small percentage of suggestions is worthy of ever getting past the preliminary stage of first discussion with the suggestor's foreman.

Rewards should be given for suggestions that bring actual improvements. But fixed rewards are hard to arrive at. The committee can have certain bases for rewards, but should make the suggestions to the management for final adjustment. The reward will probably vary in every case; sometimes, it may be a flat sum, other times a given percentage of net saving over a given period, or finally it may be a better job or an increase in pay.

A suggestion committee, made up as above, especially if alternated every six months with different foremen, will by its very nature promote worth-while discussions of current shop problems. The foremen will also keep in closer contact with each other, and with the engineering department. The result will be that the meetings of the "suggestion committee" will also prove the best kind of foremen's meetings, and the foremen and members of the engineering department will begin to consider it an honor to be appointed to serve on it for a period. —JAMES ENGLAND, *Foreman.*

* * * * *

Best Results When Foreman Passes Suggestions Along

WHENEVER I answer questions that affect my men I think them out first sort of selfish like, and I'm doing that here, so look out. I'm thinking now on the one sure-fire stand that however well off I can make myself as foreman, and better some day, depends on how well off I can make my men. If they come up, why so will I. If they get credit—why that don't even need answering, for they are my men.

Therefore the best plan to secure attention for suggestions made by my men is for me to advertise and prove how capable they are to make good suggestions. Ever notice how hard it is for an unknown to put something good across? Ever notice how easy for a man with a reputation to get listened to? That answers the first question. I will get a good line of dependable reputations for my men, then I'll sell their suggestions to my boss.

I don't think suggestions get "passed on" through anyone and ever get much of anywhere. No one wants anything that costs nothing. Give me a good suggestion to sell for one of my men, though, and that's something different again.

I don't accept credit for suggestions but I do use the added reputation that must be paid to my suggestors to better their position and therefore my own.

The superintendent can deal direct if he wishes, but with my system I've found that my worker wants me in on any discussions for, you see, he feels he can get the best results through me for his agent.

—GEORGE HERMAN, *Foreman.*

* * * * *

A Superintendent Speaks

EVERY broad-minded foreman will encourage his men to make suggestions and will gladly pass them up the line, giving proper credit to the men making the suggestions. I would discharge any foreman that would not do this.

Dealings of any kind between the men and the higher-ups should be through the foremen. It is not right to jump over the head of your immediate superior in order to reach the man higher-up.

Any foreman who would accept suggestions from his men and pass them along as his own, is not fit for his job. If the suggestions are adopted and improve the work of the department, the foreman will get credit for increased efficiency.

In dealing with men, the superintendent should always make the foremen his mouthpiece. Otherwise the men will have less respect for the foremen and will be apt to ignore them in their efforts to reach the higher-ups.

I think rewards should always be given for good suggestions, if for nothing else than incentives for others. —JOHN RAND, *Superintendent.*

THE · NEXT · TOPIC

Where Shall We Start Apprentices?

QUESTIONS

Is the traditional way of training apprentices in the shop still the best?

Should they be given all the dirty jobs available?

How often should they be shifted from one machine or department to another?

Is there any advantage in putting them on assembly early in their indenture?

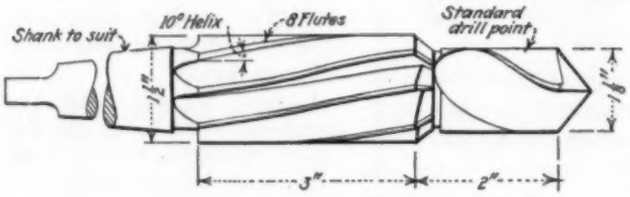
Ideas from Practical Men

The department, "Ideas from Practical Men," is devoted to the exchange of information on methods useful to the machinery industries. Its scope includes all divisions of the machine building industry, from drafting room to shipping platform. Descriptions of methods or devices that have proved their value are carefully considered, and those published are paid for. The rates are from five dollars upward, according to their merit

Tool for Machining Ports in Cylinder Bushings

BY FRANK WALDO

The combination drilling, reaming and milling tool for machining ports in locomotive cylinder-bushings, shown in the illustration, is made of high-speed steel, hardened and ground. It is used in a milling machine in which the work is mounted on a circular table. The end of the tool is machined to a drill point, 2 in. in



Port-cutting tool

length. In the center portion an eight-flute, left-hand, helical milling cutter, 3 in. in length, is provided. The helix angle is 10 deg. A cutter of this angle was found to cut more freely and to produce a better finish than cutters having other angles.

The cast-iron cylinder bushings machined with this tool have walls varying from ¾ to 1 in. in thickness so that the drill breaks through before the 45-deg. reaming portion of the cutter enters the work. When the cutter is through the bushing wall the circular table is revolved until the proper length of port has been machined. The dimensions given can be altered to suit work of different sizes.

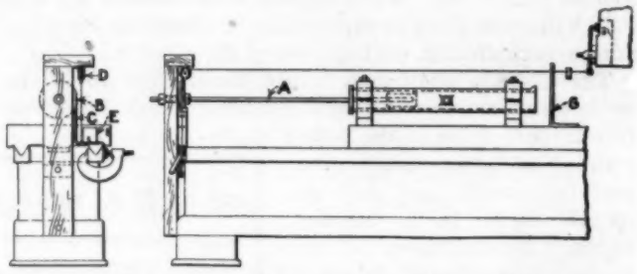
A Makeshift Lapping Device

BY JOSEPH E. FENNO

During the World War I was employed in a jobbing shop, where many times it was necessary to exercise considerable ingenuity to accomplish the desired results.

One of the jobs that fell to my lot, was the lapping of the bores of a large lot of recoil cylinders. The work was done on a 24-planer, the cylinders being mounted in V-blocks. The planer was rigged up as shown in the illustration.

A 2x4-in. timber, attached to the end of a planer bed, had a hole bored in it in line with the cylinder, and a bushing was set therein to act as a bearing for the tube *A* that carried the lap. The 6-in. milling cutter *B* was keyed to the tube near the outer end and acted as a ratchet to turn the lap. Thrust collars were so placed



Planer converted into a lapping machine

as to keep the tube from moving endwise, yet allowing it to revolve freely.

The pawl *C* was made from a heavy, flat spring, bent and attached to the planer bed by a C-clamp as shown, the upper end being in engagement with the teeth of the milling cutter. A cable attached to the pawl, and passing over the pulley *D* led to an eyebar in the toolpost, the eyebar being bent and the end furnished with a nut, so as to prevent the clapper block from swinging. The heavy weight *E* was fastened to the horizontal part of the pawl to insure its return to the normal position.

A tappet on the cable, in connection with the upright *G*, provided means of actuating the pawl as the table traveled back and forth. The lap was composed of abrasive blocks set in an aluminum body and backed up by coil springs.

In operation, the cylinder was carried back and forth over the lap by the motion of the table, and, as the upright *G* came in contact with the tappet on the cable, the cable lifted the pawl, causing the milling cutter to make part of a revolution, thus imparting the same movement to the lap.

While this device was seemingly crude, it enabled us to lap 1,800 cylinders without giving any trouble.

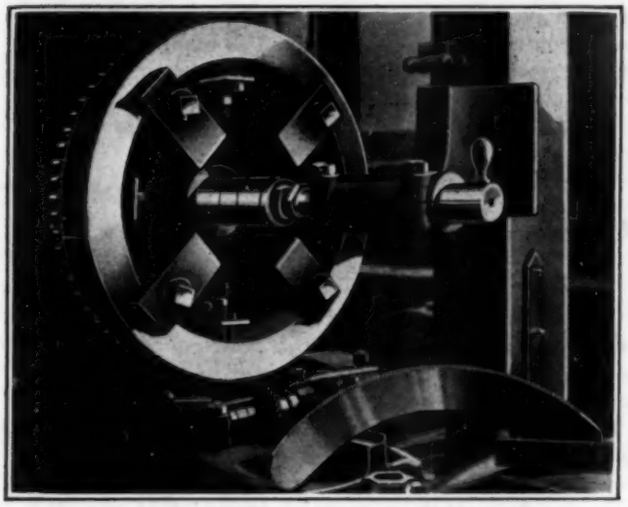
Making Locomotive Quadrants

BY GEORGE FELTNER

Quadrants for the reversing gears of locomotives are generally made from single forgings. Such work is awkward to handle and unless made in sufficient quantities to warrant the construction of special fixtures, necessitates considerable trouble in setting up for machining.

In one railroad shop, the material for quadrants is bent into a ring of the proper diameter and welded. It is then bored, faced and turned in the usual manner.

For cutting the teeth, two such rings are mounted in tandem in a gear cutter, as shown in the accompanying illustration. The faceplate on which the rings



Cutting the teeth in quadrants

are mounted, is provided with four, equally-spaced centering screws and the necessary clamps. Since three units are to be cut from each ring, the requisite number of teeth are cut in three groups spaced 120 deg. apart.

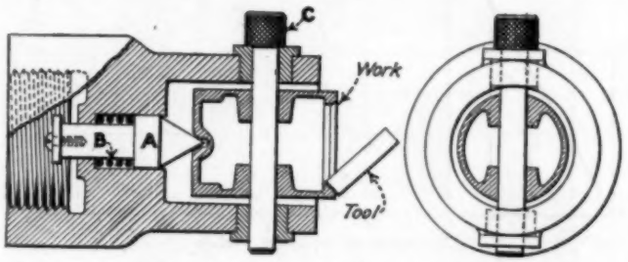
After the teeth have been cut, the rings are sawed into units and the ends drilled and rounded. A completed quadrant can be seen in the foreground.

Chuck for Beveling the Open Ends of Pistons

By Lester Rolfe

To insure accuracy in beveling the open end of a piston, so that in subsequent turning operations it will be machined square with the piston-pin hole when it is mounted on centers, necessitated the chucking fixture illustrated. The piston, made of aluminum, is 2¼ in. in diameter and is used in a single-cylinder, two-cycle gasoline engine.

First, the piston-pin hole is drilled and reamed to size, after which the center is machined on the head



Chuck for machining pistons

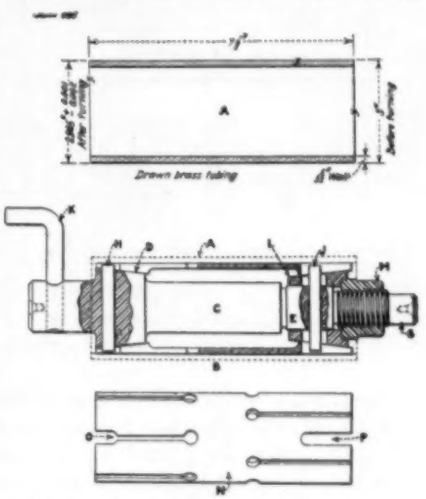
end. The piston is then placed in the chuck, and the center *A* is forced outwardly by the spring *B* with sufficient pressure to hold it in alignment while the beveling is being done. The locating pin *C* passes through the hardened bushings in the chuck and through the pin hole in the piston. A three-point contact is provided by this method, and, if the work has been reamed and centered properly, there is little chance of misalignment in beveling the open end. The plug *C* is a wringing fit in the work and in the bushings in the chuck. Threads are machined in the chuck body to fit the spindle nose, although an adapter can be used if desired.

Expanding Mandrel for Thin Tubing

By C. W. Parks

It is difficult to turn thin brass tubing unless it is very well supported, for the tube springs away from the tool and causes vibration or "chatter." In the example shown at *A* in the illustration, the tubing was originally 3 in. outside diameter and was to be turned and polished to 2.965 in. in diameter.

A special mandrel as shown at *B* was made in duplicate, enabling the operator to load one mandrel while the work on the other is being turned. The central portion of the arbor *C* is made from machine steel packhardened, and ground at *D* and *E*. Pins are inserted at *H* and *J* for driving purposes, and a bent steel rod at *K* makes a permanent driver for the arbor itself. The cone-shaped bushing *L* is slotted so that it can move longitudinally on the cylindrical portion *E* and the special nut *M* is threaded to fit the threads on the arbor, thus giving adjustment to the bushing.



The expanding mandrel

The steel sleeve *N* is slotted as shown in six places at each end to provide for expansion, and slots at *O* and *P* are provided for the pin drivers. The outside diameter of the sleeve is 0.003 in. less than the inside diameter of the tube. When the nut *M* is screwed up, the sleeve is expanded so that it grips the tube very firmly at each end. With light cutting, such as is required in this case, no vibration or chatter was apparent. When removing the work from the arbor, after the nut *M* is unscrewed, a light tap of the end *S* on the bench is sufficient to loosen the sleeve so that work slides off without difficulty.

A Fixture for Grinding Radii

By H. G. Fiedler

Some time ago we were called upon to make some punches and dies of the shape shown in Fig. 1. Since the order called for a lot of duplicate punches, it was decided to make a fixture for grinding the radii.

The fixture is shown in Fig. 2. The punches were first ground on the flat sides to within 0.002 in. of the finished size, the allowance being for shearing them into the dies. For grinding the radii, the punches were placed in the slot *A* of the fixture, the adjusting screws *B* having been previously set so that the dimension *C* would equal the corresponding dimension in Fig. 1. The clamp *D* was then slipped in place and the screws *E* tightened. The shank ends of the punches rested against the stop *G*.

The fixture was placed between the centers of a

Brown & Sharpe universal grinder. The internal grinding attachment was used because it would accommodate a small wheel, which was necessary to prevent interference with the fixture at the points *H*. The fixture was, of course, swung about the centers, though the relative positions of it and the grinding wheel, shown

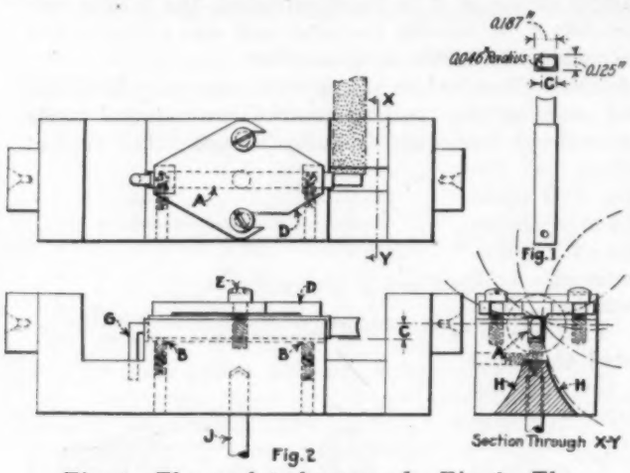


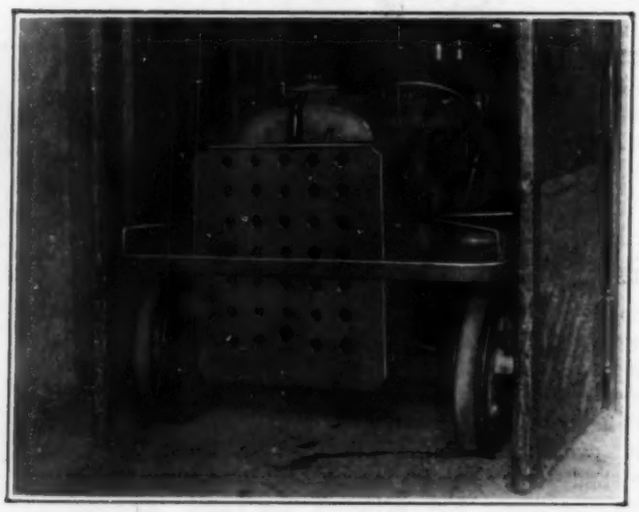
Fig. 1—The work to be ground. Fig. 2—The radius-grinding fixture

in dotted lines, would indicate that the wheel and not the work moved. The bar *J*, used as a lever to swing the fixture, was made to strike a stop in such a position as would prevent the wheel from contacting with the flat sides of the punches. To grind the radii on the opposite side, the punches were reversed in the fixture.

Door-Opening Bumper on a Shop Tractor

BY LESTER ROLFE

In winter when shop doors are closed to save heat, the movement of trucks in and out of buildings necessitates the opening and closing of doors, requiring considerable time in the course of a day, if handled by the



Shop tractor equipped with door bumper

trucker. Many plants use tractors for transportation purposes, where the operator has to stop before and after entering the building to open and close the door.

By equipping the tractor with a bumper and guard such as illustrated and installing swinging doors, loss of time can be eliminated. The doors are covered at the line of contact with sheet metal. The bumper, made of 1 x 2-in. steel, is placed around the tractor so the doors do not come in contact with the wheels. A plate is mounted on the front of the tractor so trailers can be pushed without bending the bumper.

Chart of Shell Sizes for Second Drawing

BY L. COLEMAN DOUGLAS

On page 953, Vol. 64, of the *American Machinist*, I described a chart showing the relation between the diameter of a blank and the diameter of the shell to be made from it in the first draw.

The chart herewith can be used to determine the diameter of shell to be made in the second drawing operation, based on the shell made by the first draw.

By the first chart, it was determined that the shell for the first draw, from a blank 17 in. in diameter,

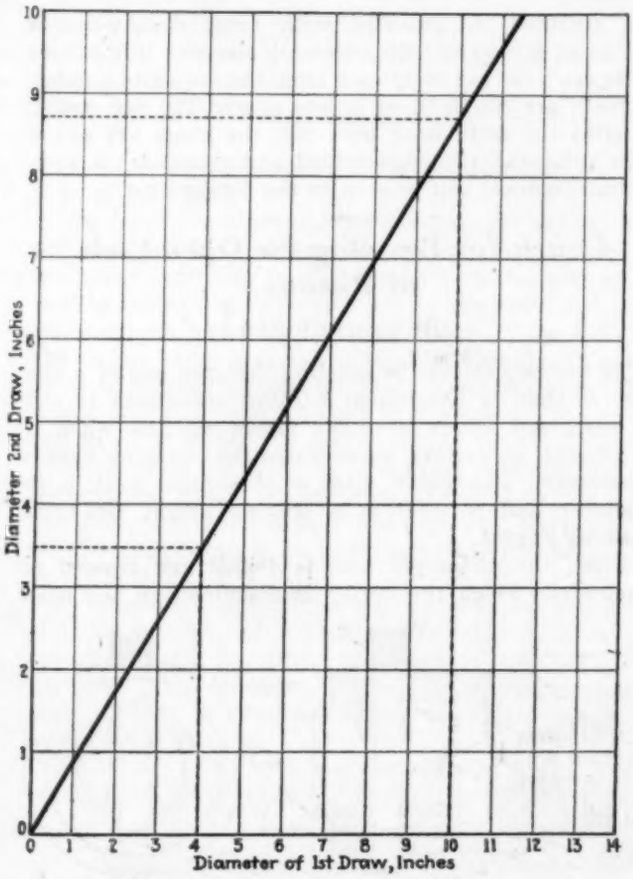


Chart giving second-drawing sizes for shells

should be 10 in. To find the size of shell to be made in the second draw, trace upwards vertically, in the chart herewith, from the 10-in. point to the curve, and then horizontally to the left. Here it will be found that the diameter of the shell to be made in the second draw will be 8⅜ in. approximately. The dash-dot lines show the process.

This chart was plotted from actual production work, where the wall reduction was from 0.001 to 0.002 in. in the second draw. The chart may be used either for steel or brass, but when used for steel it is advisable to keep the wall reduction to the minimum.

Ball-Bearing Mounting Methods

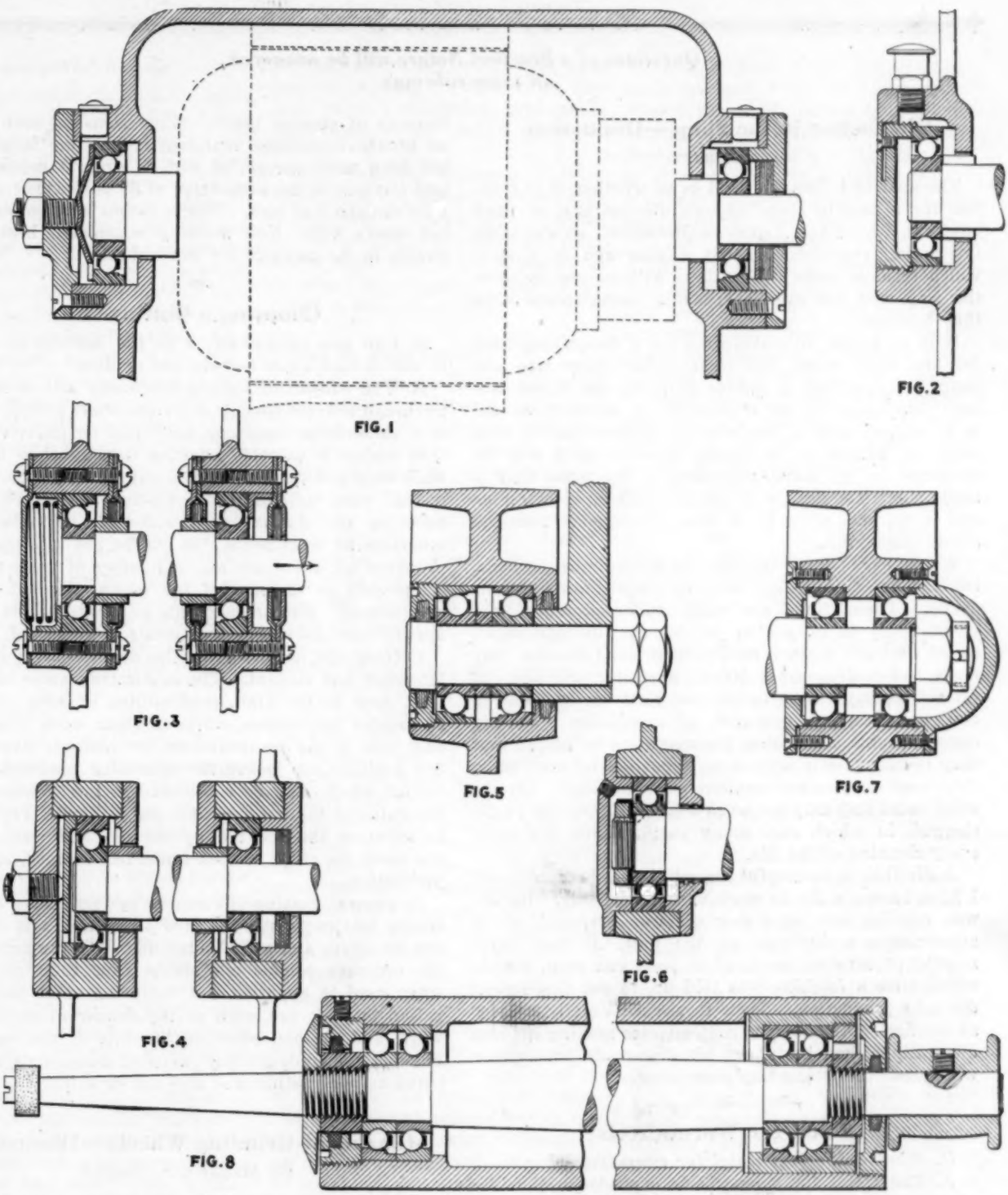


Fig. 1—Small motor bearing mountings. Fig. 2—Split lock-nut adjustment. Figs. 3-4—Through-bore mountings. Fig. 5—Belt idler-pulley bearing. Fig. 6—Bearing for load concentrated at end of shaft extension. A roller-bearing at other end carries the load. Fig. 7—Bearing for small truck wheels. Fig. 8—Bearings for high-speed grinding spindle.

For the designs recommended we are indebted to the Norma-Hoffmann Bearings Corp.

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Practical Shop Problems

Questions of a Practical Nature will be answered in these columns

Die Casting in the Shop—Discussion

BY ENTROPY

The answer to the question as to whether it is feasible for a firm to make its own die-castings, on page 764, Vol. 64, of the *American Machinist*, recalls some interesting experiences about a year ago in a shop which tried to make die-castings with no one to show the way who had even a speaking acquaintance with that business.

It is no harder to make a die for a die-casting than for any other work, but what is the right size and shape is apparently a gamble until the die it put into use. Shrinkage of metal depends on whether the die is so shaped that it can shrink. Every casting may come out broken by shrinkage stresses, or it may be stretched out of shape, according to the metal that is being run. The design of the core pullers, ejector pins and so on, may often be of more consequence than the actual diemaking.

We may reason out the way the gating must be done, but are never sure just how the metal flows into the cavity. Die-castings are made under pressure anywhere from 40 lb. per sq. in. up. A die into which metal may be poured gently with good results may make bad castings at a 100-lb. pressure. No one can predict what pressure to use nor what the best gating may be, except as a matter of experience. Venting causes trouble, and unless the vents are so placed that they are completely opened to inspection between shots they may clog up and produce poor castings. On the other hand they may not work well until they are partly clogged, in which case many castings are lost after every cleaning of the die.

A die that is successful cannot always be duplicated. I have known a die to work almost perfectly. Its life was running out, so a new die was prepared, to all appearances a duplicate of the first. It took three months of constant work of at least one man, during which time a machine was tied up, to get this second die into production. Then it worked exactly as well as the first. Anyone who contemplates making his own die-castings, had best have his dies made by someone who knows the job by long experience.

Metal for Wormwheels

Q. What is the best metal for wormwheels?

A. The metal for wormwheels depends on the kind of duty that is expected of them. We know of cases where a cast-iron wormwheel has been used for ten years as the feed mechanism of a fairly heavy machine, one where the feed pressure is all that a strong operator would care to exert with a 3-ft. bar. This worm is still in condition. It is, of course, flooded with lubricant.

In most cases, however, it is probably safer to advocate a bronze wormwheel, but here is where the differences of opinion begin. Some advocate such alloys as bronze containing manganese, but one large user has been more successful with a straight copper, tin, lead mixture in the proportion of 88 per cent of copper, 10 of tin and 2 of lead. This is rather hard to machine, but wears well. New metal is considered highly desirable in the castings for wormwheels.

Choosing a Cutting-Oil

Q. Can you inform us as to the best types of oils to use in high-speed cutting and drilling?

A. The subject of cutting-lubricants and coolants is too broad to treat adequately in one short article. There is a voluminous handbook published on industrial oils that makes a valuable addition to any shop library. Each shop will find that it will pay to do a little experimental work with different cutting-oils before finally adopting any standards. Besides the unlimited combinations of ingredients that can be put into the shop-prepared oil, there are also a number of trade-marked compounds on the market for which excellent results are claimed. Each maker puts out instructions on the applications and special treatments of his brand.

Cutting-oils usually have the double duties of both lubricant and coolant. The lubricating value on some jobs, such as the high-speed milling of alloy steels, is of greater importance, while on other work almost the only use of the compound is for cooling. Generally, five qualities are looked for in cutting compounds, any one of which may be considered of major importance according to the nature of the job at hand. These are: Lubricating the cut, cooling the tool and work, washing away the chips, adding finish to the work, and rust prevention.

In general, cutting-oils may be put into three classes: Heavy lubricants such as lard oil, soluble oils containing an alkali, and sulphonated oils. The importance of the ordinary soluble oils comes from their cheapness when used in quantity, but there are often objections raised to their use, such as the danger of rusting the work, and the bad effect on the skin of the workmen. Some of the trade-marked prepared compounds are featured as non-rusting and also non-smoking.

Glazing of Grinding Wheels—Discussion

BY MAURICE S. DESSAU

While your answer to the question on page 956, Vol. 64, of the *American Machinist*, is correct in every sense of the word, it is possible that the inquirer is dressing his wheel with some kind of a dresser that assists in glazing the wheel. Although I do not believe he is using a diamond tool to dress his wheel in grinding cast iron, it is quite possible that he is employing some dresser that does glaze the wheel.

Technical Abstracts

Electric Industrial Truck

The electrical industrial truck has been found well fitted for transporting a variety of materials ranging from tin plate to molten glass and from cloth to pig iron. Auxiliary attachments have made it possible to increase the general usefulness of standard models of this equipment. For materials which must be handled in an unusual way, specially engineered modifications of the electric industrial truck have been developed.

There are five major types of electric industrial truck equipment—the straight platform truck, the low lift truck, the high lift or tiering truck, the crane and the tractor. Each of these types has many uses. Plant conditions, such as size of elevators, width and surface of runways and the grades of ramps, occasionally dictate slight modifications in the standard length, height or wheel base of trucks, but such changes are readily made. Harold J. Payne in *Factory*, June, 1926, p. 103.

Small Tools

It makes little difference whether it's a small shop or a large one, keeping tools in good order is just as essential to either one. Perhaps very few shop superintendents have tried to check up the time that is actually lost on a job because some of the smaller tools are either not sharp or worn to such an extent that they ought to be replaced. Where the mechanic works on piece work and has his own tool kit, one will usually find tools kept in good shape. However, with company owned tool kits the tool equipment receives an unusual amount of abuse, unless some checking system is employed which would show up the "butchers."

Another thing which should be carefully checked is the completeness of various tool sets. This applies particularly to drill and tap sets, socket wrenches, punches, etc. It is usually the particular size that is missing that is the one most needed. By a systematic check up on such tools and by keeping them in good order, the missing sizes are quickly detected and the mechanic's time is not wasted pawing around the shop benches looking for a certain size drill which perhaps was broken the week before but not replaced in the set.

The careless treatment which small tools are given in some shops is appalling. This could be overcome if the mechanic would realize that better kept tools make it easier to do the job.—*Operation and Maintenance*, June 10, p. 33.

Scales in Production

Weighing scales could be used in many ways to facilitate production; for example, for counting material in large amounts. Some times special differential scales are used for this purpose. One of the parts is placed in the small pan and a larger number of parts, to counterbalance, in the larger pan, and the scale gives the number.

In one large automobile plant scales are used for testing the compression of clutch springs, of carburetor springs and brake springs. In another plant a roller conveyor is so arranged that parts of its track go over a scale platform and the contents can be weighed on a scale as they pass through. Scales are also used for sorting connecting rods according to weight. They are also used in steel yards for finding the number of bars of steel in a given bundle. Altogether the use of scales has a tendency to speed up mass production.—*The Iron Age*, June 10, p. 1635.

Training Foremen

A foreman should be a real manager. To function as a manager of a department, the foreman must be in possession of managerial facts, information, and understanding regarding his department. The average factory foreman is responsible for a return on a larger investment in plant, machinery, material, and payroll than most people realize—an investment larger than that involved in the establishments of most good-sized mercantile businesses. And yet, the management of an industrial enterprise is apt to drop this real responsibility in the lap of a foreman without much consideration as to his competence as a manager. Most foremen are picked because of outstanding ability as individual producers, and little or no thought is given to more important considerations relative to their ability as managers or their ability to supervise and to handle men.

The program of foremanship development in the plants of the Oakland Motor Car Co. has definitely improved the quality of their products, measured in reduced cost of replacements and adjustments in the field based on defective workmanship. It has reduced accidents and injuries in the shops, measured by nearly 60 per cent reduction in the average annual cost per man of accident compensation, hospital bills, doctor bills, and first aid treatment. Glenn L. Gardiner, Oakland Motor Car Co., in *Industrial Management*, May, 1926, p. 290.

Reboring Air-Pump Cylinders

A machine designed for the special purpose of reboring the cylinders of Westinghouse air pumps has resulted in reducing the production time of from 8 or 9 hours to about 2½ hours. This machine is used in the air brake repair department.

Before the installation of this machine, the air pump cylinder reboring was done either on a horizontal or a vertical boring mill—machines costing from $6,000 to $8,000. Each cylinder was bored separately, and the time per pump varied from 8 to 9 hours, not counting the extra time spent in moving the pumps to and from the air brake repair department. Now the air brake repair men, by using the special machine do the air pump reboring themselves. All four cylinders of a cross-compound pump can be bored simultaneously or a single cylinder can be bored if desired. The time required to rebore all four cylinders varies from 2 hours and 20 minutes to about 3 hours. This range of time was taken from the actual floor to floor time records kept for over one year.—*Machinery*, June, 1926, p. 763.

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Impossible and Unnecessary Specifications

SPECIFICATIONS have more to do with the cost of a product than many imagine. Likewise, the time of delivery is also directly affected thereby.

There is probably no one way in which the government could save more money than by having its specifications for machinery and material written by practical engineers. Among some recent examples are those calling for accuracy far in excess of requirements and eliminating all tolerances. Tests were demanded that proved nothing except that the man who wrote the specifications had no practical knowledge whatever about the subject.

The effect of such specifications is not to secure the best products but rather to prevent the best manufacturers from bidding. For, knowing that the requirements are unnecessary, and frequently impossible of fulfillment, they know that nothing but trouble and dissatisfaction can come of dealing with the men who demand them.

There are, of course, a few notable exceptions to these criticisms. At least one department has so simplified and modernized the specifications as to secure the complete co-operation of manufacturers. It has thereby simplified its problem of supply and secures material promptly and at a reasonable cost.

The great tendency is to specify too much and to stress unimportant details.

Revise the Calendar

SLAVES to tradition as we are it will probably be some time before we can revise our antiquated calendar to make it fit present-day requirements. A few valiant crusaders have been struggling for some years to awaken public interest in a modern calendar but without much effect.

There is every good reason to change our present awkward system to a more useful one and no good reason why we should not. From the business man's viewpoint it would mean far simpler accounting methods and monthly intervals that would be equal and therefore comparable.

Because of the vagaries of the present calendar Vol. 64 of the "American Machinist" had only 25 numbers while Vol. 65 will have 27. The two volumes published in 1925 had together 53 issues. Comparisons of the business done in corresponding periods are therefore misleading.

The wage earner, the housekeeper and the small shopkeeper would benefit equally from a calendar revision that would put the same number of paydays in every month. It therefore behooves every one of us to keep the subject alive until the desired revision is accomplished.

A By-Product of Apprentice Instruction

NOT all of the benefits resulting from apprentice instruction can be measured. The course itself will attract high-class boys. The instruction will bring about more thorough work, and the boys will know the "why" of what they are doing. They will become better citizens as well as better journeymen.

Perhaps a good part of the work of the boys themselves can be measured. However, there is another effect of their training that can be estimated only; it is the effect upon the man who is a graduate of the school of hard knocks, the man in the shop who has never had apprentice instruction. Experience has demonstrated that he will hump himself to keep up with the apprentices as they progress in the school. He does not like to know less than they do, wants to be ready to answer their questions, and will study to keep in advance of them.

Class instruction of apprentices, even of foremen, is feasible. The same kind of instruction for the workers at large is beset with difficulty. As a by-product of apprentice training, instruction of journeymen is not only possible and practicable; it is free.

Sticking Too Close to the Job

ATTENTION or stick-to-it-ive-ness has long been considered as one of the foundation stones of success. And yet it may be possible to overdo it, according to the executive of a well known business enterprise. In his opinion he has lost much by sticking too close to the job.

He has been very successful in earning for his concern the reputation of building an excellent product and has made money for all concerned. But he feels that the same end might have been accomplished had he learned how to diversify his activities earlier in life. His close application to the office has left him little time for keeping in touch with other plants or for making many acquaintances among other engineers, both of which he feels is a distinct loss. He points to others who have taken more time away from the shop, who have succeeded equally well and, in addition, have a host of pleasant and valuable friends.

Is this a modern example of the old adage that "all work and no play makes Jack a dull boy"?

Finding the Diameter of Blanks for Flanged Shells

By Ronald Wakelee

IN THE accompanying diagrams are given graphical methods for determining blank diameters for the three flanged shells as shown in Figs. 1, 3 and 5. The formulas upon which the graphical solutions depend are based upon the established rule that the area of the blank is equal to the combined areas of the various components making up the shell whose walls are considered as having no thickness.

In Fig. 2 is shown a layout for ascertaining the diameter of a blank that will form a cup whose dimensions are given in Fig. 1. By geometry we know that

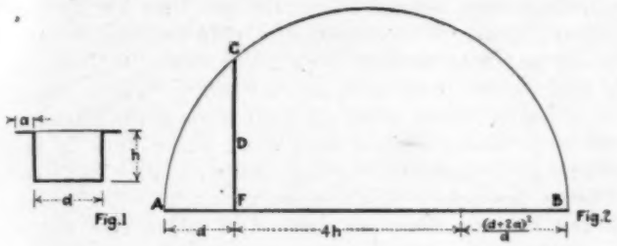


Fig. 1—The cylindrical flanged shell. Fig. 2—Layout for the cylindrical flanged shell

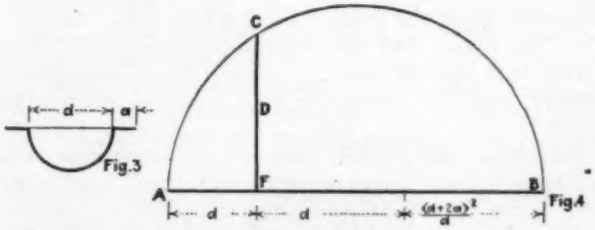


Fig. 3—The flanged hemisphere. Fig. 4—Layout for the flanged hemisphere

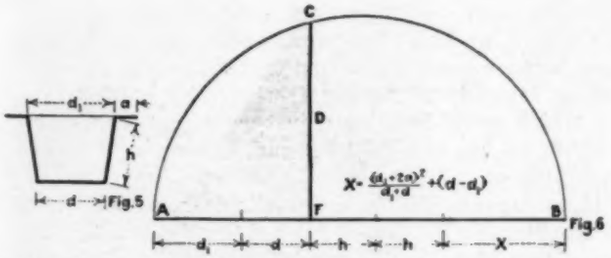


Fig. 5—The tapered flanged shell. Fig. 6—Layout for tapered flanged shell

the perpendicular erected on the diameter of a circle is the mean proportion between the two segments of the diameter. In Fig. 2, $\frac{AF}{FC} = \frac{FC}{FB}$ is the equation of which *FC* or *D* is the mean proportion.

In order to find the area of the cup shown in Fig. 1, it is necessary to compute the area of the base of the cup added to the area of the sides and that of the flange of the cup. The area of the base of the cup will be $\frac{\pi d^2}{4}$ and that of the sides of the cup will be πdh. The area of the flange will be found by subtracting $\frac{\pi d^2}{4}$ from the area of the circle whose diameter is $d + 2a$. Our total area is therefore:

$$\left[\frac{\pi(d+2a)^2}{4} - \frac{\pi d^2}{4}\right] + \frac{\pi d^2}{4} + \pi dh$$

If we equate this area to that of the desired blank whose diameter, *D*, we wish to find, we will have:

$$\frac{\pi(d+2a)^2}{4} + \pi dh = \frac{\pi D^2}{4}$$

Simplifying:

$$(d+2a)^2 + 4dh = D^2 \qquad (1)$$

$$D = \sqrt{(d+2a)^2 + 4dh} \qquad (2)$$

Equation (2) will serve to compute the diameter of the blank.

In order to lay out the diagram as in Fig. 2, we can rewrite equation (1) as:

$$D^2 = d\left[\frac{(d+2a)^2}{d} + 4h\right]$$

making use of our rule on the mean proportion:

$$d : D = D : \left[\frac{(d+2a)^2}{d} + 4h\right]$$

We know, therefore, that if we lay out a line, measure off the three parts *d*, $4h$ and $\frac{(d+2a)^2}{d}$ and upon this determined length as a diameter layout a semicircle, the perpendicular *D* erected at a distance *d* from the end of the line will be the diameter of the blank desired.

In order to find the diameter of the blank required to make a shell as illustrated in Fig. 3, the first step is to find the area of the hemisphere and that of the flange. The area of the hemisphere is $\frac{\pi d^2}{2}$, and, as before, the area of the flange is $\frac{\pi(d+2a)^2}{4} - \frac{\pi d^2}{4}$.

The area of the blank will be:

$$\frac{\pi D^2}{4} = \frac{\pi(d+2a)^2}{4} - \frac{\pi d^2}{4} + \frac{\pi d^2}{2}.$$

Simplifying:

$$D^2 = (d+2a)^2 + d^2 \qquad (3)$$

$$D = \sqrt{(d+2a)^2 + d^2} \qquad (4)$$

Equation (4) is the one for computing the diameter of the blank.

For laying out the diagram as in Fig. 4, equation (3) can be rewritten:

$$D^2 = d\left[\frac{(d+2a)^2}{d} + d\right]$$

By proportion:

$$d : D = D : \left[\frac{(d+2a)^2}{d} + d\right]$$

The area of the blank for the shell illustrated in Fig 5 may be obtained by means of a similar process. The lateral area of the frustrum of a cone is $\frac{\pi h(d_1 + d)}{2}$. The area of the base of the cup is $\frac{\pi d^2}{4}$. The area of the flange is $\frac{\pi(d_1+2a)^2}{4} - \frac{\pi d_1^2}{4}$

Adding the component areas:

$$\frac{\pi d^2}{4} = \left[\frac{\pi (d_1 + 2a)^2}{4} - \frac{\pi d_1^2}{4}\right] + \frac{\pi h (d_1 + d)}{2} + \pi d^2$$

Simplifying:

$$D^2 = (d_1 + 2a)^2 + 2h(d_1 + d) + d^2 - d_1^2 \qquad (5)$$

$$D = \sqrt{(d_1 + 2a)^2 + 2h(d_1 + d) + d^2 - d_1^2} \qquad (6)$$

Equation (5) may be rewritten:

$$D^2 = (d_1 + 2a)^2 + 2h(d_1 + d) + (d_1 + d)(d - d_1)$$

or: $$D^2 = (d_1 + d)\left[\frac{(d_1 + 2a)^2}{(d_1 + d)} + 2h + (d - d_1)\right]$$

$$d_1 + d : D = D : \left[\frac{(d_1 + 2a)^2}{(d_1 + d)} + 2h + (d - d_1)\right].$$

Equation (6) can be used for computing the diameter of the blank and equation (7) may be used for laying out the blank.

Horse Sense in Inspecting Work

By John R. Godfrey

MY OLD friend Johnson has been having some friction in the shop between the foreman and a new chief inspector. He wasn't a new man, for he'd come up through the works, but he'd annexed some cocky notions since he got his new title, so the Old Man had to "call" him a little. Then to get the whole matter straightened out, he had an informal meeting of the foremen and inspectors to thresh the whole thing out. And he asked me to sit in on the confab.

"Boys," he said, "this inspection proposition has a lot more to it than appears on the surface. And the sooner we all understand it, the better for the Johnson Motor Co. Just let me emphasize the fact that the inspector who thinks it's his job to reject as much work as possible, is starting off on the wrong foot. His job is to pass as much work as is possible—that is, work that will meet requirements. And this is just as true for the parts we buy as the parts we make.

"Take a 'con' rod, for example. The holes at both ends want to be within the right limits to give the proper fits. Gages take care of this if they are used intelligently, which they frequently are *not*. There isn't so much chance to get fooled on the 'go' and 'no-go' plugs in the rod ends as there is with snap gages. I've seen snap gages forced over a shaft that was several thousandths large and work called too small when the gage slipped over, with almost no pressure, as it ought to.

"Then, too, I've heard an inspector cuss a man for turning a piston too large, when the only trouble was temperature. The piston had been turned in a cold corner of the shop and then laid around near the stove before it was tried in the assembly. I've also seen valve cages made with such a small tolerance that dipping them into a tank of hot soda water expanded them so they were large for the gage. But this was the fault of those who set the tolerance, much more than of the inspector.

"I've seen inspectors reject a 'con' rod or a rocker arm because of a slight hammer mark made in driving in the bolt. Nothing that would injure the rod in any way, but enough to secure its rejection. This is particularly true when the rods are bought on the outside and when you have a good supply on hand—at other times you'd pass 'em and never see the hammer marks.

"Of course, we can't give every inspector full discretion. Some we can't give any. The only safe way is to have all rejections looked over by someone who knows whether defects are really serious enough to affect the strength, or fit, or usefulness of the piece.

"A lot of our inspection troubles come from attachments bought outside, like carburetors, ignition apparatus, etc. And I suspect much of it is our own fault. I'm inclined to believe we specify too much. What we are really interested in is performance and continued service, and that the apparatus will fit the place we have designed and built for it. Why should we specify such details as the size of screw to hold in the top of the carburetor? And why should we bother to gage them when they come in?

"When we are getting complete apparatus from a reliable source, it's a waste of time to bother with much inspection beyond the usual test they get in the finished engine. We've been supplying engines to several car and boat builders who never think of inspecting them at all until they get a running test in their cars or boats. Even when we make some slight changes from our regular design, they don't waste time in inspecting every piece before they put the engine in place.

"Some inspectors don't seem to know what gages are for or how they are used, and adjustable gages should be set—and sealed—only in the tool room.

"I've seen bolts rejected because the inspector had set the gage so large that the standard screw plug shook in the gage as much as the bolts did. It's been a mystery to me just how he expected to find a nut that was a good fit on the gage, receive a bolt that was tight in the ring gage. And that rejection cost a lot of money in delay that was an absolute waste. Those bolts were standard and the inspector didn't know enough to know it.

"There's an old saying that a little knowledge is a dangerous thing. That goes for a lot of inspectors. Horse sense is conspicuous by not being on the job, and horse sense is the best asset an inspector, or anyone else, can have.

"It doesn't hurt the man in the office a bit, either.

"A lot of inspection trouble comes from fool specifications that try to take care of every detail, just as though we were dealing with a bunch of crooks. During the war, we had fillets dimensioned to four decimal places because some draftsman translated 5 millimeters literally instead of making it three-sixteenths of an inch, which would have been just as good. It was only an air-fit on the outside of a gun, but we made gages to four places.

"If we try and follow a few simple rules we'll have less trouble. So I've jotted down a few for you to think over. Here they are:

"Don't specify any more details than are necessary.

"Don't call for greater accuracy than is needed to secure proper functioning of the mechanism.

"Remember that the maker of a standard product has built up his business by supplying satisfactory machinery to his customers. Don't ask him to change details that his experience has proved to be right, and to give satisfactory service because of a whim of our own."

Anyone who has watched inspection, rejection and the grief that goes along with them, will be inclined to believe that the old man isn't so far wrong on the subject.

Shop Equipment News

"Coulter" Diamond-Tool Boring Machine

The automatic Machine Co. of Bridgeport, Conn., has developed the "Coulter" diamond-tool boring machine for boring the wristpin and crank bearings in connecting rods for automotive engines. A front view of the machine, Fig. 1, shows the method of locating the work, the fixture in which it is held, and the independent boring bars that do the actual boring. From the rear view, Fig. 2, may be gained an idea of the automatic mechanism that brings about the various movements.

The machine is driven by a 3-hp. motor placed inside the column with only the pulley projecting. From the motor pulley a belt drives the horizontal shaft that may be seen in Fig. 2, and from this shaft a belt, running over adjustable idlers, drives the spindles through the vertical shaft that may be seen above

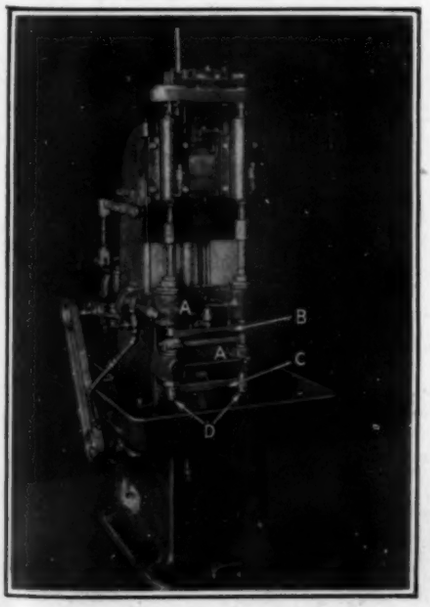


Fig. 1—"Coulter" Diamond-Tool Boring Machine

the cam drum. The cycle movement is also driven from the horizontal shaft through a double worm-and-wormwheel speed reduction unit.

The column of the machine above the splash-pan is of open-side box section, between the sides of which the feed cam drum and its driving mechanism are located. The cam shaft is mounted on ball bearings, both radial and thrust, while above and in line with it is the high-speed shaft through which power is transmitted to the boring spindles. The lower bearing of the high-speed shaft is carried in the same housing as the upper bearing of the cam shaft.

The high-speed shaft passes through and is splined to the hub of the spindle-driving pulley, which is carried by a roller bearing in a bracket that projects rearwardly from the sliding head of the machine. From this pulley a single belt, running over an adjustable idler to maintain the tension, drives both boring spindles.

The spindles run in bronze sleeve bearings 12 in. long. The journals are tapered, with the larger diameter at the upper end of the bearing, and the spindles are provided with ring adjusting nuts to compensate for wear of the bearings. Ball bearings above and below the spindle pulleys sustain the radial load produced by the tension of the belt, thus relieving the long sleeve bearings of lateral strain.

The entire head moves up and down on the column, guided in its movements by the cam upon the vertical shaft behind it. The weight of the head is supported upon the cam by a substantial bronze shoe instead of a roller. The feed movement is actuated by gravity and its rate is determined by the lead and the circumferential speed of the cam.

In Fig. 1, *AA* is a fixture that is bolted to the face of the column and has no movement. The boring bars, which are separate from the spindles that drive them, pass through cast-iron sleeve bearings in the upper part of the fixture. The bars are attached to the driving spindles by means of special floating couplings of the Oldham type, each having a tapered shank extending upward into the corresponding tapered hole in the spindle and a similar shank connected in the same way to the boring bars, so that the latter may be disconnected from the spindles either above or below the couplings.

In the lower bearings of the fixture are sliding, but non-rotating, spindles that serve to locate the work. At the upper ends of these

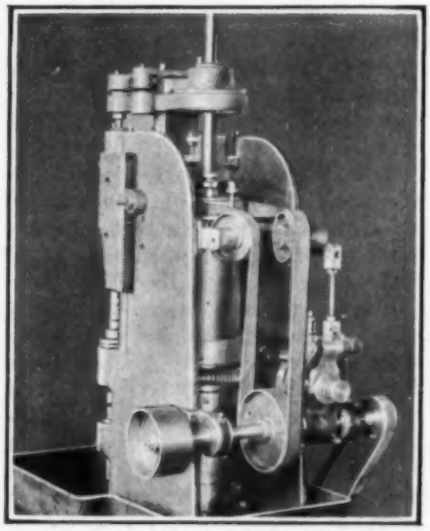


Fig. 2—Rear view of machine

spindles where they project through their bearings are plugs to fit the rough bores of the work. An axial hole in each plug receives a pilot on the lower end of the respective boring bar, which is thus supported close to the cut in addition to the support afforded by the sleeve bearing of the fixture. The clamping bar *B* and the lower cross-bar *C* are carried by vertical slides that project through the column and fixture, and derive their movement from the main cam.

The cam shaft derives its motion from the horizontal shaft in the rear of the machine through the double worm-and-wormwheel reduction gear before mentioned, in the first member of which is a spring-loaded friction clutch that is governed by the operator's trip lever to start, but by the automatic movement of the head to stop. In the belt-driven pulley at the lower end of the high-speed

Shop Equipment News

vertical shaft above the cam is a similar clutch, entirely automatically operated, to perform the same function for the boring spindles. The spring in each clutch acts as a safety feature in case of overload or accidental interference with the automatic movements.

The cycle of the machine is as follows: In the starting position, which is as shown in Fig. 1, the spindles are at rest and the sliding head is at the top of its stroke. The plugs in the upper ends of the locating spindles *DD* project about ⅛ in. from the faces of their respective bearings. The operator places a connecting rod over these plugs and depresses the trip lever on the side of the machine at his left, thus engaging the friction clutch in the cam driving train and starting the cycle.

The clamp bar *B* moves down to the work, but does not pinch it at this time. The locating spindles rise, actuated through the bar *C* by their cam, and push the plugs clear through the rough-bored holes in order to locate the work exactly. The clamp bar is then forced down tightly to hold it for boring. The head descends rapidly until the pilots on the boring bars enter the axial holes in the locating plugs. Not until this moment do the spindles start to revolve. They are set in motion by the automatic engagement of the second clutch.

The rotating bars and the non-rotating locating spindles descend slowly together, their relative positions being maintained, until the boring tools have done their work. The spindle driving clutch is then released, and, when the bars have stopped rotating, the parts return to their several original positions. The stoppage of the boring tools before withdrawal prevents them from cutting a helical groove in the finished surface as they pass back through the bored holes. The boring tools are specially formed diamonds, made expressly for this machine. One spindle revolves at a rate of 2,500 and the other 5,000 r.p.m. The floor to floor time is one minute.

A pump, driven by belt from the horizontal shaft on the back of the machine, delivers a special lubricating compound to both the cutting tools and the sleeve bearings of the fixture and the pilots of the boring bars. The compound is piped to the upper bearings of the fixture and through the center of the locating spindles to the work and pilots. The bronze sleeve bearings of the main spindles are oiled by means of sight-feed lubricators.

This machine weighs 3,900 lb., and occupies approximately 30x40 in. of floor space.

Springfield Heavy-Duty Double-Head Face Grinder

A heavy-duty double-head face grinder is being put on the market by The Springfield Manufacturing Co., Bridgeport, Conn. The machine, shown in the accompanying illustration, is designed for the simultaneous grinding of two opposite sides of castings.

The reciprocating table has a working length of 84 in., and a working width of 36 in. between the grinding wheels. Specially designed 30-in. sectional chucks are supported on driving spindles 6 in. in diameter. These spindles are provided with ball bearings for taking the grinding thrust.

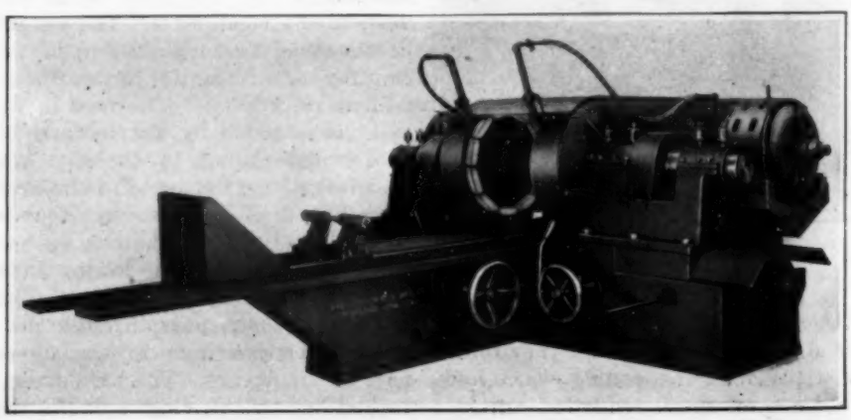
The sectional chucks are intended to take the standard shapes of abrasive blocks furnished by the various grinding wheel manufacturers, and either silicate or vitrified blocks can be used. The chucks are built in two sections. The outer ring, which holds the abrasive blocks, consists of a steel casting bolted to a heavy spider. The latter is dish-shaped at the center and is heavily braced. The design is claimed to reduce to a minimum any liability of spring or distortion in the chuck.

The chuck jaws are a floating type, and each jaw is provided with a screw device for feeding the blocks forward as they become worn. No blocking pieces are needed for keeping the abrasive segments in the proper cutting position. By counting the number of turns of the wrench, the operator can feed the abrasive blocks forward the same distance. The adjusting mechanism is completely covered and protected from water and abrasive particles.

Each grinding spindle is driven by a 40-hp. motor connected to the spindle by a silent chain. The spindle bearings are lubricated by large sight-feed oilers to insure a constant and ample supply of clean oil. The wheel heads can be operated singly, or they can be locked together by a positive locking arrangement.

The machine can be controlled by the operator from either side, and each wheel-head is equipped with a lever for controlling it independently of the other head. The wheel-heads are fed by means of large screws fitted with thrust ball bearings.

The bed of the machine is of solid construction, braced throughout with heavy box-section ribs. The table drive is by means of rack and gear train, and all gear shafts run in bronze-lined bushings. A 3-hp. motor furnishes the power for driving the table and the coolant pump. The machine is fitted with a complete equipment of water guards. The weight of the machine with motors is 23,000 pounds.



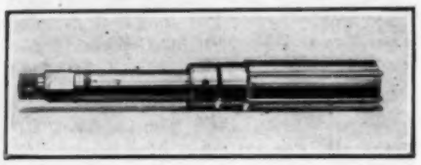
Springfield Heavy-Duty Double-Head Face Grinder

Shop Equipment News

Foster-Johnson Hand Reamer, Adjustable

The adjustable hand reamer, illustrated, is being made by the Foster-Johnson Reamer Co., Elkhardt, Ind., in various sizes.

The blades of the reamer expand parallel and may be expanded when inserted full length into the work. The adjustment of the blades is effected through the medium of the



Foster-Johnson Adjustable Hand Reamer

knurled nut located at the top of the reamer. The bottom part of the nut is graduated to read the amount of expansion or contraction in thousandths of an inch. The reamer is removed from the work by contracting the blades and lifting straight out.

A feature of the tool is that the blades of the reamer when expanded in the work do not enter the latter at once but are only firmly seated against the walls until revolved. During the first quarter revolution the blades feed out to the full depth of the cut to which they are adjusted. This action is accomplished through the spring collar.

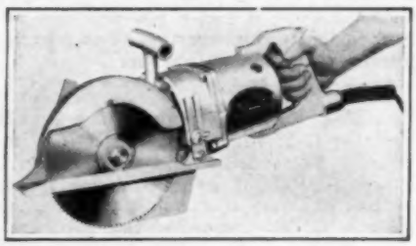
The reamer is built in five sizes, ranging from 1⅜ to 4¾ in. The range of expansion varies from ⅛ in. on the 1⅜-in. to ¼ in. on the 4¾-in. size.

Michel Electric Hand Saw

The electrically-driven hand saw illustrated is being placed on the market by the Michel Electric Hand Saw Co., 3814 Ravenswood Ave., Chicago, Ill., under the trade name of "Skilsaw."

The saw is driven by means of a General Electric universal motor that operates on either d.c. or a.c., single phase. Cord and a plug are provided for connecting the unit to an ordinary lighting circuit. The handle of the machine resembles an ordinary saw handle and is provided with a trigger control for the motor circuit for convenience.

A guard is placed over the top of the saw and a guide is placed in line with and to the rear of it to insure a continuous straight cut. An adjustable depth gage limits the depth



Michel Electric Hand Saw

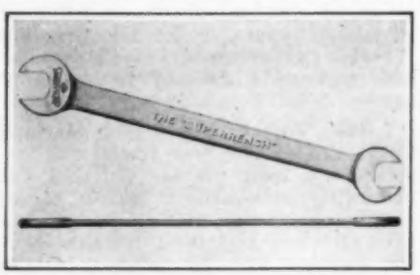
of cut. In this way it is possible to cut through flooring without touching the concrete beneath or nicking the sleepers.

The unit is readily portable and is intended for maintenance and repair work, cutting out sections of flooring, reclaiming box and crate lumber, and building work of all kinds. It weighs nineteen pounds.

Williams Tappet and Check-Nut "Superrenches"

The addition of tappet and checks-nut wrenches to their line of chrome-molybdenum "Superrenches" has been made by J. H. Williams & Co., Buffalo, N. Y. They are especially designed for the adjustment of tappets.

The wrenches have been made sufficiently long to prevent burning the hands while working on the



Williams Tappet and Check-Nut "Superrench"

tappets of hot motors. They are long and light with thin heads and jaws. It is claimed that they are well adapted to use on check nuts. They are heat-treated and nickel finished with the heads buffed bright and the body left black.

Pamphlets Received

Consider the Approach. The policyholders' Service Bureau of the Metropolitan Life Insurance Co., 1 Madison Ave., New York, N. Y., has published a little booklet under the above title. It comprises a series of suggested collection letters for credit houses. The letters avoid "soft soap," but are not strong enough to estrange the customer. They are intended instead to put him at ease.

Grinding Wheels. Simplified Practice Recommendation No. 45. Prepared by the U. S. Department of Commerce and issued by the Bureau of Standards, Washington, D. C. This report is another step in the direction of the elimination of waste in industry. A list of producers, distributors and users of grinding wheels that have accepted this practice is given. Recommendations for fourteen types of wheels follow together with the various sizes in each type. About sixty-five per cent of the total variety has been eliminated.

Nickel Cast Iron. The International Nickel Co., 67 Wall Street, New York, N. Y., has published Bulletins Nos. 201 and 202 of a series on nickel cast iron. The first bulletin is entitled "Properties and Applications of Nickel and Nickel Chromium Cast Iron." It consists of four 8½x11-in. pages, perforated for binding, in which are tabulated the improvements to be secured by the addition of nickel or nickel and chromium to cast iron. It also contains a summary of the savings effected, a partial list of applications, and a list of materials available for making the alloy addition. Six illustrations of typical nickel cast iron applications are shown, each with a brief description. Bulletin No. 202 is entitled "Improving Gray Cast Iron With Nickel." This is a 12-page bulletin of 8½x11-in. pages, perforated for binding, in which all essential information required by the foundryman, metallurgist, or engineer is presented in brief form with tables, illustrations, commercial applications, and instructions for making the nickel or nickel and chromium addition to the cast iron. These bulletins are not advertising literature but are written in true text-book style.

Our World Trade. The Foreign Commerce Department of the Chamber of Commerce of the United States, Washington, D. C., has published its quarterly bulletin, January to March, 1926. The value and volume of the principal exports and imports between the United States and the chief foreign markets are given through the medium of text and fifteen tables.

Sheet Steel. Simplified Practice Recommendation No. 28 has been pub-

lished by the Department of Commerce and issued by the Bureau of Standards, Washington, D. C. This booklet contains a list of manufacturers, contractors, distributors, and consumers that have accepted this recommendation. The standard sheets are classified according to gage and sheet size. The results of the first and second sessions of the first revision meeting are also given, as well as a complete history of the movement toward the simplification of sheet steel.

Abnormal vs. Normal Tool Steels. By F. G. Sefing. Bulletin No. 5 of the Michigan Engineering Experiment Station, East Lansing, Mich. This pamphlet discusses the relation which exists between the hardness of properly hardened plain carbon tool steel and the microstructure of annealed steel.

Trade Catalogs

Blower Systems. The Kirk & Blum Manufacturing Co., Cincinnati, Ohio, has issued an attractively illustrated 50-page booklet called "Kirk & Blum Blower Systems." Considerable space is devoted to the fundamentals of blower engineering. The remainder describes and illustrates typical installations in well-known plants of various types in the woodworking, metal-working, and miscellaneous industries. A list of users of this system is appended.

Chain Drives. The Boston Gear Works Sales Co., Norfolk Downs (Quincy), Mass., has issued a small booklet of standardized industrial chain drives, rated according to horsepower, speed and ratio. Specifications for various kinds of chain are also given.

Control Equipment. The General Electric Co., Schenectady, N. Y., has issued a bulletin on its type MT control equipment for direct-current series-wound crane bridge and trolley motors.

Coupling, Flexible. Poole Engineering and Machine Co., Baltimore, Md., Bulletin No. 108 describes the Poole flexible coupling. A numbered cross-sectional view is used to explain the construction of the device. Specifications and principal dimensions are given.

Cranes, Hand. Herbert Morris, Inc., Buffalo, N. Y., Book No. 104 describes Morris hand cranes. Specifications are given for Type S cranes using a single cross I-beam and for Type G cranes using double cross I-beams. Detailed descriptions of the cranes and trolleys are given. The booklet contains thirty-two pages and it is illustrated with photographs and drawings.

Drives, Machine Tool. Link-Belt Co., 910 S. Michigan Ave., Chicago, Ill., Book 812 is devoted to Link-Belt silent chain drives for machine tools. General principles are discussed, then the automatic idler and the chain itself is described. The remainder of the book, composed of thirty-six pages, is largely pictorial and shows typical applications of chain drives to various types of machine tools.

Fans, Man-Cooling. The American Blower Co., Detroit, Mich., is issuing a large size leaflet describing its man-cooling fans for use with furnaces, forges and other equipment that subjects workmen to high temperatures.

Forges, Rivet. The Johnston Manufacturing Co., Minneapolis, Minn., has issued an illustrated leaflet describing its line of rivet forges. Two types are shown. Type R has a low-pressure oil burner, while the other type has a high-pressure vacuum oil burner.

Gears, "Fibroc." The Fibroc Insulation Co., Valparaiso, Ind., has issued Bulletin G-1, entitled "Silent Gears of Fibroc, Their Uses and Advantages." Fibroc consists of layers of paper, linen, or the like impregnated with Bakelite resin. A description of the manufacture of the gears and their properties is given. Engineering information and tables are appended.

Grinding Machines for Drills. William Sellers & Co., Inc., Philadelphia, Pa., has published catalog No. 501 in which its No. 2-A drill grinding machine is described. The construction and operation of the machine is explained in detail with the aid of photographs.

Grinding Machine, Internal. The Heald Machine Co., Worcester, Mass., has issued Bulletin No. 527 of general information and setting-up instructions on its "Size-matic" internal grinding machine, Style No. 72. The booklet goes into detail in explaining how each unit of this new automatic grinder is set up and adjusted. Some of the features of the machine are an automatic diamond wheel-turning device and an hydraulic table feed mechanism. The booklet is illustrated.

Grinding Wheels and Abrasives. Abrasive Co., Philadelphia, Pa., catalog No. 8 is divided into three parts. The first thirty-three pages are devoted to the manufacture and selection of grade of "Abrasive" and the manufacture and use of wheels. The second section of 181 pages contains dimensions and prices of standard shapes of grinding wheels as approved by the Grinding Wheel Manufacturers' Association. The last section is devoted to polishing grades.

Lathes, Turret. The Gisholt Machine Co., Madison, Wis., has issued two circulars describing the new 3 L and 4 L full-swing side-carriage turret lathes employing a cross-feeding turret. In both circulars a general description of the machines and the standard tools is given with the aid of numerous photographs. Sketches and photographs of typical set-ups are also shown. Complete specifications of the machines are given.

Lathe, Turret. The Warner & Swasey Co., Cleveland, Ohio, has published a 30-page bulletin describing its No. 3-A turret lathe. Specifications are complete in every detail. The covered ways are explained by word, picture, and numerous cross-sectional views, then the alloy-steel head, the bed, the hexagon turret, the square-turret carriage, and other details are similarly treated. There is a photograph and description of every tool and chuck, together with dimension drawings of same for use in figuring clearances.

Lock Washers. The Mansfield Lock Washer Co., Mansfield, Ohio, has issued illustrated catalog No. 4 of its product. S.A.E. standard lock washers, commercial lock washers, and special lock washers are listed. The stock number, code word, price, bolt size and section size are given.

Pneumatic Tools, Portable. The Warner & Swasey Co., Cleveland, Ohio, has issued a 15-page illustrated bulletin describing its portable pneumatic tools. The principle of operation of the air motor is explained by means of diagrams. Types D-1 and D-3 grinders and Type E-3 drill are then treated in turn in some detail.

Riveting Machines. The Hanna Engineering Works, 1765 Elston Ave., Chicago, Ill., has issued a bulletin entitled, "Transportation Depends on Riveting." Many illustrations and the text show how pneumatic riveting machines are used in building locomotives, freight cars, and bridges. Various types of machines are also shown.

Soldering Iron. The General Electric Co., Schenectady, N. Y., has issued a leaflet describing its improved electric soldering iron. Complete specifications are given.

Tools, Production, "Wear-Ever." The tool division of Scully-Jones & Co., 2012 West 13th St., Chicago, Ill., has recently published catalog 35 showing small tools and accessories for drilling, tapping, reaming and milling operations. Several new tools have been added. Considerable space is given to the "Wear-Ever" chucks for taps, drills, reamers, and miscellaneous cutters. A line of milling cutters is also listed. Some useful tables are appended.

Welding, Arc. The General Electric Co., Schenectady, N. Y., has published a bulletin entitled, "Arc Welding in G-E Factories." The story is told in pictures with brief captions as the sole text. Twenty-eight 8x10½-in. pages are used to show the many uses of arc welding in making other products of this company.

Welding and Cutting Apparatus. The Alexander Milburn Co., 1416 West Baltimore St., Baltimore, Md., has published a small booklet in which its torches, regulators, and welding outfits are described. Acetylene generators, a paint spraying outfit, and oil preheating torch are also listed.

Wire Rope. The American Cable Co., 105 Hudson Street, New York, N. Y., has published a booklet, entitled "The Wire Rope Users' Handbook," that contains some useful information about the manufacture and proper use of its products. Methods of splicing and socketing the wire are given. A general price list and a telegraphic code are also included.

News of the Week

Executives Discuss the Foreman's Job From Management Point of View

Meeting at Silver Bay devoted to exchange of experiences between managers in different industries

A three-day session of the production executives division of the American Management Association was held at Silver Bay, Lake George, N. Y., on June 30, July 1 and 2, under the supervision of Frank P. Cox, manager of the West Lynn Works of the General Electric Co. After a welcome by Manager Towson of the Silver Bay Association, Mr. Cox expressed his belief that there was no formula, no one best way that would meet all conditions of management.

A. Sylvester of the Atlantic Refining Co. told of the success of his company in establishing foremen as group managers and of including them and other "indirect" workers in a group that shared in a bonus made possible by their saving in production costs. In this plan the foreman makes a daily record from which the bonus is calculated. This record also serves to inform him just how work is progressing in his department.

Question of Management

The paper provoked a lively discussion that ranged from the advisability of foremen keeping records, to questioning the statement that a foreman was a manager in the sense that he had any discretion such as the term manager implies. The advisability of including the foreman in the bonus was also discussed, the general opinion being that it is unfair to reward other workers for extra effort and not include foremen, either in a bonus, by salary increases, or in other ways.

One session was devoted to the relation of the foreman to the personnel department, at which it seemed to be the general opinion that, with proper understanding and co-operation they could be of great help to each other. Discipline is a duty of the foreman and he should not shift it to personnel. In fact each department should understand the function of the other, and each stick to its own.

The question of instructing workers came up under this head and here the solution offered seemed to depend on the size of the group under a foreman. Apprentice training was relegated to a school with a proper instructor, frequently picked by the foreman, from his own men. But the final instruction, either of the apprentice or of a new employee in the department, should, it was held, be the foreman's duty. He should be able to show the employee just how he wants the work done.

Nearly every paper presented touched on the problem of foremen's responsibility and their authority, bringing out widely differing ideas as to both. The discussion in every case showed the effect of the organization to which the foreman belonged and of the personality of those directly above the foreman, on the duties and responsibilities of the foreman himself. These differences make him the virtual manager of a small shop in some cases and in others merely a clerk or errand boy of the general manager. And the latter condition exists in small organizations as well as in large.

The Foreman's Duties

The general topics at the different sessions were: "The Foreman's Job," "Qualifications and Development of Foremen," and "The Foreman's Pay." Under these headings practically every phase of the foreman's duties and qualifications was discussed, and with a freedom that was refreshing.

There was little discussion of the statement that the policies of the company could best be sold to the employees through the foremen. It was pointed out that both from the matter of policy and from the reaction on the men as well as on the foremen, the foremen should have advance information on all contemplated changes. Not only is he justified in resenting the posting of a change on the bulletin board before he knows of it, but this has a bad effect on his standing with his men. If the foreman doesn't know of a change before it is announced, the men feel that the foreman is not in the confidence of the management and he cannot, if he would, sell the idea as effectively as though he knew in advance, as he can then frequently pave the way for even radical changes.

The foreman's position and duties were very neatly summed up by Henry Metcalfe who stated that both the authority and responsibility of a foreman were dependent on his function in the organization. In too many places the foreman is held responsible for matters over which his duties give him no control, and there are many organizations in which the foreman's job is perhaps the hardest of any and where all the talk about foremen being the "key" men of industry does not prevent their being made the buffer between management and men.

Papers were presented on the "Qualifications and Selection of Supervisors," by Edward Dana, general manager, Boston Elevated Railway; "Rating Supervisors," by H. G. Ellerd, of Armour & Co.; and "Women in Supervisory Positions," by Eleanor H. Little, industrial engineer, United States Rubber Co. Frank P. Cox spoke on the "Development of Foremen," and the different phases of foremen's clubs were brought out in three papers dealing with "Community Foremen's Clubs," "Company Foremen's Clubs," and "Foremen's Meetings for Efficiency of Operations." Under the foremen's pay the question of salary versus extra incentives was discussed from several angles.

One interesting and valuable feature of the convention was the widely varying experiences of the speakers. The industries represented included textiles, rubber, oil refining, electric manufacturing, telephone operation, railway, ink, chemicals, sewing machines, motor trucks, cast-iron pipe and electric refrigeration.

S.A.E. Prepares for Coming Meetings

With its big semi-annual summer meeting just over, program committees of the Society of Automotive Engineers are busily at work on plans for three late summer and autumn national meetings of the organization. First of these is the aeronautic meeting to be held in Philadelphia on Sept. 2 and 3 at the Bellevue-Stratford Hotel, immediately preceding the opening of the national air races under the auspices of the National Aeronautic Association and after the sesqui-centennial exposition has been in progress for three months.

Next comes the annual production meeting and stag carnival of the society in Chicago, from Sept. 21 to 23, at the Hotel Sherman in conjunction with the meeting of the American Society for Steel Treating and its exhibition of machine tools and heat-treating equipment.

The third meeting of which dates have been definitely chosen is the automotive transportation and service meeting, to be held in Boston from Nov. 16 to 18 at the Copley Plaza Hotel. Plans for this contemplate one or two sessions to be held at the Massachusetts Institute of Technology, where test apparatus will be inspected.

Hearings on Magnesite

Briefs will be submitted to the Tariff Commission on July 19, by parties interested in its investigation of the costs of producing crude magnesite and caustic calcined magnesite.

The case before the commission is the result of application for a higher duty. An application filed in 1923 by four Austrian producers asking a decrease also is pending.

Revised Commerce Figures Show Increase in Exports of Industrial Machinery

Latin America and Asia feel influence of mechanical development — Europe absorbing larger volume — New method of computing machinery statistics

In the past conditions have made it difficult for the Department of Commerce to compile statistics on industrial machinery in a satisfactory manner, as certain difficulties in classification and arrangement had not yet been overcome. But during recent months the necessary changes have been made and it is anticipated that hereafter these statements will be published regularly. In publishing such a statistical statement the department aims to include returns covering only industrial machinery, by which is meant those types of machinery that are used in factories, in mines, and on construction projects.

The general statistical experience of exports of industrial machinery from the United States is shown in Table I which also is a basis from which to consider the more detailed statistics.

This table indicates the pre-war position of American machinery exports and while the returns for the year 1916 to 1918 inclusive have been omitted, it will be remembered that the trade was very large during this period, with the heaviest demand from Europe under abnormal war conditions. Following the Armistice there was a very heavy volume of business but this post-Armistice boom collapsed in 1921 and the following year witnessed the smallest volume of machinery exports from this country. Since that time there has been a gradual but consistent increase, and by 1925 the total had become nearly $150,000,000.

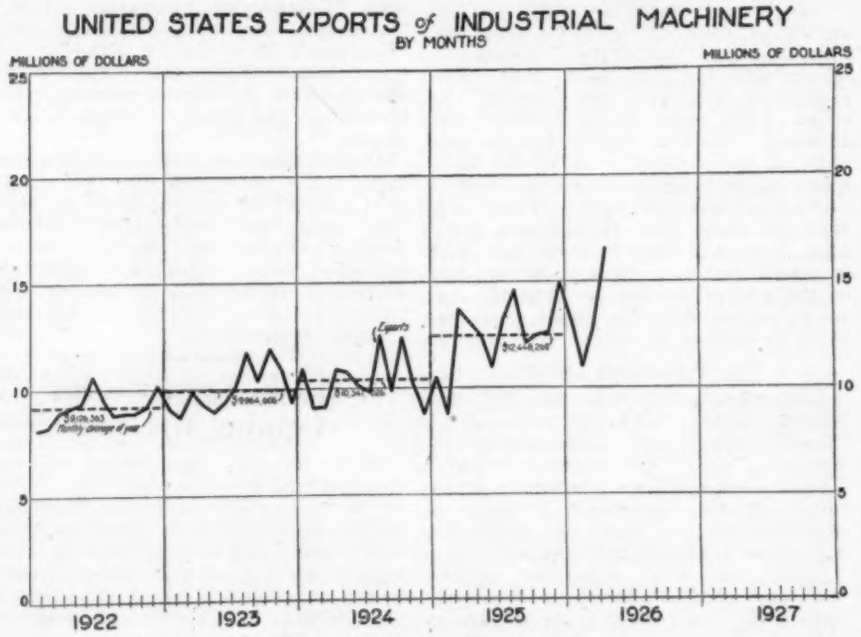


Chart No. 1 based on monthly returns

Much that is very significant can be derived from this table. For example, one should compare the volume of industrial machinery absorbed in Asia and Latin America during the years since 1919 with the pre-war years. These figures express the degree to which these comparatively undeveloped areas are becoming industrialized and as they become industrialized they are finding it possible to change the character of their trade in other commodities with Europe, the United States, and other countries, and consequently the nature of the export business from those areas is changing gradually but profoundly. The demand for comparatively crude products is diminishing but the demand for highly manufactured goods in both Asia and Latin America is increasing. Reports received from Europe indicate that manufacturers feel these influences at work and it seems safe to expect a gradual evolution of important significance along the lines indicated.

It is also interesting to note that Europe is absorbing a constantly increasing volume of American machinery and reports reaching the department would indicate that further expansion along these lines is to be anticipated.

The table is based on annual reports. A diagram based upon monthly returns gives a very different impression as indicated in Chart No. 1. As will be noted, the shipments move with very great regularity and a depression reported one month is almost sure to be followed by an abnormally large volume the succeeding month. The chart apparently proves that monthly fluctuations are not of real significance.

The value of these figures will only be appreciated when they are considered in connection with returns for earlier months and over a much wider period of time. It will be noted that on Chart No. 1 is also a dotted line giving the annual returns expressed as a monthly average. This dotted line is a far more satisfactory measure of the progress of American export trade in machinery and the trends in that trade and like the information in the table furnishes

Table I—United States Exports of Industrial Machinery

(In Thousands of Dollars)

Destination	Fiscal Years 1910	1913	1915	Calendar Years 1919	1920	1921	1922	1923	1924	1925
Canada, Newfoundland, etc.	14,113	30,637	15,449	52,346	63,157	26,966	23,010	27,719	23,297	24,134
Europe (except Balkans)	14,149	27,683	38,219	100,397	90,731	41,100	23,236	28,427	32,159	45,688
South America	4,309	7,739	4,457	24,048	28,736	23,181	11,385	14,965	19,247	26,328
Mexico and Central America	6,412	6,209	2,590	11,144	21,235	23,373	9,609	9,608	11,524	13,005
West Indies	2,763	4,877	4,013	19,369	38,387	23,780	7,026	10,254	12,701	13,100
Total Latin America	13,484	18,825	11,060	54,561	88,258	70,334	28,020	34,827	43,472	52,433
Asia (except Asia Minor)	3,666	4,377	3,777	61,880	65,308	55,599	31,037	22,577	21,826	16,582
Australasia	2,200	3,560	2,987	5,672	8,044	7,605	4,516	6,476	5,774	6,039
Africa	1,353	1,592	1,490	5,183	5,314	4,487	1,564	2,543	3,358	3,251
Other countries	152	455	282	4,640	3,440	2,707	906	1,029	950	1,252
Grand total	49,117	87,129	73,264	284,679	324,252	208,798	112,289	123,598	130,836	149,379
Percentage to:	*Per Cent*	*Per Cent*	*Per Cent*	*Per Cent*	*Per Cent*	*Per Cent*	*Per Cent*	*Per Cent*	*Per Cent*	*Per Cent*
Latin America	27.5	21.6	15.1	19.2	27.2	33.7	24.9	28.2	33.3	35.1
Asia	7.4	5.02	5.2	21.7	20.1	26.6	27.6	18.3	16.7	11.1
Canada, Newfoundland, etc.	28.7	35.3	21.1	18.4	19.5	12.9	20.5	22.4	17.8	16.2
Europe	28.8	31.9	52.2	35.2	28.0	19.7	20.7	23.0	24.6	30.6
Australasia	4.5	4.1	4.0	2.1	2.5	3.6	4.1	5.2	4.4	4.0
Africa	2.7	1.8	2.0	1.8	1.6	2.2	1.4	2.1	2.6	2.2
Other countries	.4	.5	.4	1.6	1.1	1.3	.8	.8	.7	.8

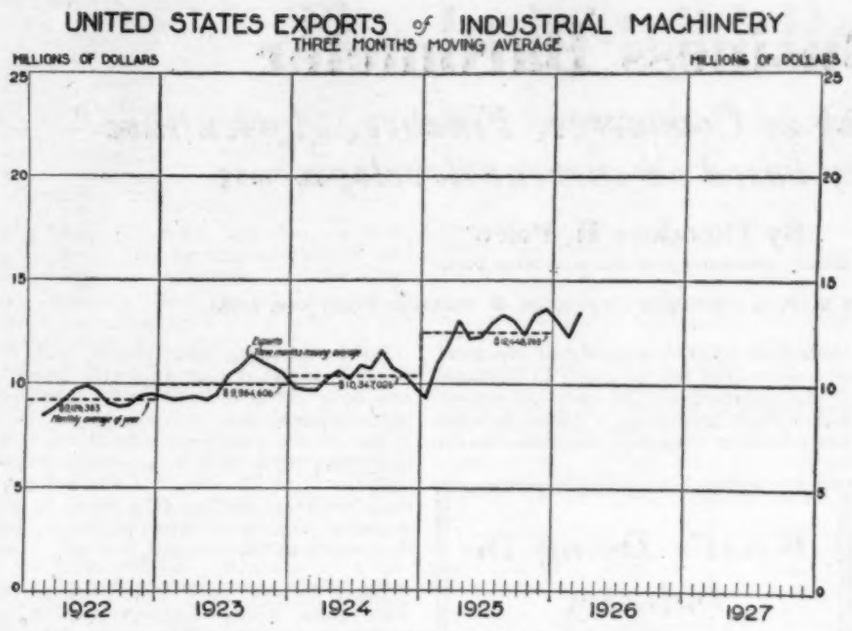


Chart No. 2 showing three-months moving average

a more perfect picture of the export situation to which it refers.

However, it is often unsatisfactory to wait until the end of the year in order to analyze these factors and an effort has been made to smooth out the irregularities in the curve on Chart No. 1 by employing a "three months moving average." The results are shown in Chart No. 2. This method makes it possible to observe the trends, in some degree at least, without waiting until the end of a calendar year.

The Department of Commerce is making an earnest effort to persuade manufacturers to co-operate in a movement to improve the dependability of these export statistics. Most manufacturers are showing a splendid spirit of co-operation and it is felt that in time these statistics will be found more and more dependable and consequently of greater value as a guide in developing export policy.

Record Performance of Airplane Engine

Announcement was made on June 16 by the Bureau of Aeronautices of the Department of the Navy of the receipt of a report of another performance by the Wright "Whirlwind" J-4 engine. The test was made at the Naval Reserve Air Station at Squantum, Mass.

The full text of the statement follows:

"Engine No. 10663 of the Wright J-4 type has completed 300 hours and 40 minutes flying time in the air. This engine has never once skipped in the air and a slight detonation at one time was caused by a broken spark plug porcelain which occurred inside the cylinder. Spark plugs have been inspected twice and two broken porcelains found. Valves have been adjusted for clearance, the average being about once for each valve. The engine has been tightened in its mounting once and is turning up more revolutions now than when new."

Similar reports regarding the reliability of engines now in use in naval aviation units are reaching the bureau as newer types of engines get into service. It is the announced intention of the Bureau of Aeronautics to procure engines capable of running a minimum of 300 hours between major overhauls.

Recommendations of Patent Office Committee

The Special Patent Office Committee, originally appointed by Secretary Work in July, 1924, has completed its full report on all phases of Patent Office activity. The report contains one hundred and eight recommendations, a few of which are summarized below. Improvement of the quality of the work is stressed by the report, although quantity is not lost sight of. Among the recommendations are: Division of administrative and judicial functions with an administrative assistant to the commissioner; appropriation of funds by Congress for a new building and new equipment; revision of various classes of patents, both active and obsolete; completion of cross-indexing and numerical indexing of patents; classification of foreign patents; restriction of claims to twenty with $1 charge for excess simplification and improvements of clerical work; increase in salaries of examiners; organization of force of twenty translators for foreign patents; addition of temporary and permanent examiners; simplification of trade-mark division; increase in filing and final fee $5 each; reduction in time for amending patents to six months; limitation of period of renewal to one year; limitation of time of appeal in *ex parte* cases to six months; and transfer of appeals to courts; use of interrogatories in patent as well as in trade-mark interferences; and making the decision of the examiner-in-chief final.

Army Aviation Program Presented to Congress

The Army aviation program, as agreed upon in conference, was presented to Congress on June 22, by representative James of Michigan, acting chairman of the House Military Affairs Committee.

The bill (House bill 10827) as agreed upon also embodies the legislation contained in bill 12471, introduced by Representative McSwain of South Carolina and bill 12472, introduced by Representative Vinson of Georgia.

To Control Designs

The Vinson-McSwain provisions in the bill involves the whole question of competitions in designs for new types of aircraft, including parts and accessories. Any establishment or individual would be enabled to submit designs to a "Patents and designs board," which, upon the recommendation of the National Advisory Committee on Aeronautics, would determine whether use of the designs by the government is desirable and necessary, evaluate the designs so submitted, and fix the worth to the United States of any design, not to exceed $75,000 for any one particular design.

The Secretaries of War or Navy would be authorized to award such contracts, "to the lowest responsible bidder that can satisfactorily perform the work or service required to the best advantage of the government," subject to review only by the President or the Federal Courts.

The latter two measures now consolidated into the Army aviation bill, embody the aircraft procurement provisions urged by the War Department and agreed upon by a joint subcommittee of the House Naval Affairs and the Military Affairs Committees, after a series of hearings of Army and Navy officials.

The conference report includes a change in the date of beginning the five-year expansion program in the air corps to July 1, 1926; appointment of a new Assistant Secretary of War to direct aero activities; establishment of air sections in the General Staff for the next three years; creation of an air mechanics grade and a provision which will make the air corps 90 per cent fliers, including commanding officers, in peace or war.

Would Organize Steel Fabricators

Representatives of fifteen steel fabricating concerns of New England met in Springfield, Mass., on June 30 and took the first steps to form an association after the lines of that now in operation in New York City. Charles L. Eidlitz, chairman of the board of directors of the Structural Steel Board of Trade of New York, explained the workings of the board. Charles Fitts, of Boston, was chairman of the meeting and he was authorized to appoint a committee to draft the plan of organization and submit it at a second meeting to be called within thirty days at a place to be selected by this committee later.

The Business Barometer

This week's outlook in Commerce, Finance, Agriculture and Industry based on current developments

By Theodore H. Price
Editor, *Commerce and Finance, New York*

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IN THE ideal world of the economist production and consumption should show an orderly and equal ratio of increase, so keeping supply and demand in equipoise.

Of course this ideal is never attained but the approximation to it that we are achieving in America is marvelous when the complex adjustments that constantly have to be made are considered. The success and promptitude with which these adjustments are effected is measured by the degree in which those who can work are gainfully employed and it is doubtful whether there was ever previously so little unemployment in the United States. It is true that about 40,000 garment makers are on strike in New York City but they compose about the only considerable group that is now idle and their idleness is unnecessary. With this exception there is work at good wages for every one and it can be truthfully said that the whole country is productively employed.

These observations are recorded by way of antidoting the talk of over-production or under-consumption that is to be heard in so many quarters. "Man never is, but always to be blest," and those who have things or labor to sell are rarely satisfied with what they can obtain. But the prosperity of the country is nevertheless amazing and it will not harm us to reflect upon it.

One aspect of this prosperity by which the thoughtful men cannot fail to be impressed is the enrolment in our summer schools and colleges. In the July number of *Scribners Magazine* it is estimated that 300,000 young men and women will enter these schools and colleges during the present week. Another equally impressive development is the number of children that are going into summer camps this year. About 100,000 children have already left New York for these summer camps and more than $140,000 is said to have been paid to the organizers of one camp for the accommodation, care and training that is provided. Taking the country as a whole the number of children who go to camp must be enormous and the cost of caring for them will run into the millions.

Now all this may not seem to have very direct relation to business, but it is nevertheless very important for it bespeaks the contentment and wealth of the nation and is the negative of the professional pessimism that some are preaching.

The stock market has shown its appreciation of existing conditions by a further advance and bond dealers say there is a positive scarcity of the good securities that are so much in demand.

The approach of the vacation season and what is practically a double holiday has probably caused some reduction in distributive trade but the retail demand has been good for the season and with warmer weather more summer goods have been sold.

But in the department stores, trade is normally quiet during July and August and no great activity is to be expected until September.

The cotton goods manufacturers are meantime organizing a campaign whose purpose is to increase the demand for their products and as they seem to be working rapidly results ought to be seen early in the autumn.

Early in the week wheat and corn were quite weak. Subsequently there was some recovery but grain futures are still "groggy" and it is reported that the farmers are selling their wheat as fast as it is threshed.

They are said to be bitterly disappointed by the defeat of the Haugen and Hess Bills and to be threatening all sorts of political reprisals at the November elections.

In the East it is believed that time will cure the agricultural discontent but to any one who knows the West this seems doubtful and a great outcry with much talk of hard times is to be expected if wheat should decline below $1 on the farms.

Secretary Jardine has announced that fifty-nine Shipping Board steamers will be put into commission for the export of grain, but as the trouble is the lack of an export demand rather than of tonnage, Mr. Jardine's action can hardly be regarded as more than a sympathetic gesture.

Sugar is showing more strength with warm weather and a better appreciation of the statistical situation which has been further strengthened by rains that have seriously damaged the European beet crop.

There have been no developments of special importance in the other commodity markets, nor has there been any significant change in the trend of American industry.

The steel mills are working at about 75 per cent of capacity and although no figures are obtainable it is not improbable that the same statement would be true of most other industries.

When it is remembered that there are but few men who work at more than 50 per cent of their capacity or for more than 15 per cent of their lives it will be admitted that 75 per cent of capacity in industry is not so bad.

These are the considerations that suggest and justify optimism as we stand at the end of the half year and look forward to the coming six months during which considerably more than half the year's business should normally be handled.

What's Doing in Industry

The outstanding feature of the present machinery and machine tool market is the outlook for the summer season. It has generally been assumed that business must drop off during July and August—and seldom has the trade been disappointed. But this year the opposite seems to be probable.

Manufacturers and dealers are almost unanimous in predicting a good business in the next two months. Inquiries are not plentiful, it is true, but there is considerable activity on old quotations. Railroads are quite active and contemplated automotive expansions offer much prospective business.

Detroit looks for an early break in the market, with automobile manufacturers buying again for expansions. Inquiries are better in Cincinnati, forecasting orders from industrial and automotive plants. Milwaukee reports a spotty condition, but prospects are bright. Cleveland is looking forward to immediate business from general industries and public utilities.

In the East the New England market is making substantial progress, buying is active and prospects are bright. Railroads are taking some equipment in the New York market. Buffalo reports June better than May, with good business pending. Inquiries are favorable in Philadelphia and some fair orders are expected in the next few weeks.

General business conditions justify optimism as we stand at the end of the half year and look forward to the coming six months during which considerably more than half the year's business should normally be handled.

The Industrial Review

Progress of the machinery and machine-tool business in various parts of the country

THE following reports, gathered from the various machinery and machine tool centers of the country, indicate the trend of business in these industries and what may be expected from the future:

Milwaukee

While the call for metal-working equipment continues to be decidedly spotty as to origin and volume, manufacturers of tools manage to maintain production at a steady rate. Deliveries, as a rule, find replacement on the order books without decided inequalities that would unbalance production schedules, and this is regarded as one of the most satisfactory features of the situation. Rarely does an order call for more than one or two items, and usually quick delivery is specified.

The experience of the structural fabricating trade is reflected by the condition of the tool market. Fabricators have a moderately satisfactory tonnage on their books, but it consists of many little jobs, and so far as foundry and machine shop work is concerned, this consists mainly of repair work or inconsequential extensions. The lack of large industrial construction jobs finds the usual counterpart in the absence of heavy buying of metal-working equipment.

Automobile factories present the most favorable prospect for new business in the coming three to six months. The motor industry has not done much buying for two to three months, compared with the state of activity throughout last year and early this year. Prospective business, however, doubtless will be limited to a few sources.

Railroad business continues to develop very slowly but the outlook is considered good.

Cleveland

Buying of machinery and machine tools for the past fortnight showed a decline from its previous high mark of the first half of June. The volume of sales booked for the first part of June was unusually heavy and producers were hopeful that June would surpass any month of the year.

Best business at present is in the automatic machine line. The General Motors Corporation was a recent buyer of a large list of automatics. One local manufacturer has enough orders on hand to continue production for the next four months in the event no additional business is booked.

The Cleveland Board of Education will soon be in the market for new and replacement tools for its various manual training departments. Authorization to purchase tools was made on June 28. Lists of the requirements are being prepared.

Buffalo

With final figures unavailable for the month of June at the time this was written, it was still the consensus of opinion among the leaders in the machinery business in Buffalo that June would prove to be a much better month than May.

It develops that buying was held up somewhat in May because of timidity on the part of some industrial leaders resulting from the earlier Wall Street activity. The renewal of buying activity in June indicates that industrial confidence in the present economic situation has been restored in a large measure.

Activity in electrical equipment still shows the greatest relative activity but the machine tool business proper in recent weeks has shown signs of reaching an equal position of activity.

The demand for contractors' equipment is also better with every indication that it will continue good during the next few weeks.

General industrial conditions in Buffalo are excellent. Some industries are reporting greater activity during the last few weeks than at any time in their existence The automotive field is particularly good and the Buffalo Automobile Dealers' Association reports that car sales for the first five months of the year were sixteen and one-third per cent greater than for the same period 1925.

Pessimism which prevailed during much of the second quarter in the machine tool trade has been almost entirely dissipated in the last two weeks of June.

Cincinnati

The backbone of the past week's market for machine tool manufacturers of Cincinnati was the sales to general machinists and industrial users. Selling agents report that they found the demand rather small, but no more than a seasonable dullness. Taking into consideration the fact that the Fourth of July holiday shortened the week, manufacturers and selling agents consider it a satisfactory one.

Orders on hand and those coming in, it is thought, will keep factory production at its present level through the summer, after which a much greater activity is expected. The strike of the iron molders has ended and all manufacturing conditions are favorable.

The majority of the manufacturers report that sales of the past week were larger than in the corresponding week of last year. The principal part of the week's bookings consisted of orders for replacements and single tools, these being well scattered and well diversied. An encouraging number of inquiries came in during the week, these being well scattered and from concerns in various industries.

The railroads did some buying in the week, but no large orders were placed. The automotive industries made a few scattering purchases. Some sales were also made to concerns in the electrical line. General conditions are regarded as favorable and the common feeling is one of confidence.

Detroit

An increased number of inquiries for machine tools and machinery leads Detroit dealers to believe that a break is coming in the dull period which has extended for some time in this automotive center. Engineering staffs of the automobile and accessory plants are making up lists of new equipment which is necessary for the maintenance of the present high production schedules. A general bolstering of every manufacturing plant seems destined.

General Motors is showing more activity than any others at the present time. A large portion of the machinery for the Chevrolet plant at Flint has been ordered. and lists are out on other tools. The new Pontiac plant is being rushed to completion and part of its equipment has been ordered. Cadillac is preparing plans for a new light-eight and the old Fisher Body Corporation plant on Michigan Ave. will be used in its manufacture. Practically all new equipment will be needed. The GMC truck plant has added some tools to the toolroom and die rooms.

Hudson and Essex are buying in larger quantities than for some time. Studebaker is doing practically nothing with the exception of replacing a machine here and there. Packard has temporarily shut down on buying while the engineering staff works out the problem of revamping the assembly line. The Jewett plant is tooled up, but some small stuff is being placed in the Paige plant.

Ford remains the big question mark. The steel mill at the Fordson plant is going forward rapidly, but buying for the other departments is slow at present.

New York

Dealers and agents in this market are quite optimistic over business prospects for the summer months. There are many deals pending that are expected to close in the next few weeks and inquiries which have not been acted upon give assurance of a fair volume of orders during the usually dull summer season.

The past week registered increased activity among railroad buyers. The Illinois Central placed some good business, some of which found its way into this market. The New York Central also bought several machines. Authorities have announced that orders will be placed within ten days for many of the tools listed on the inquiry issued several weeks ago by the B.M.T. Railway. This list totals about fifty machines.

Orders placed in the last week included planers, automatic milling machines, jig borers, geared-head lathes, shapers and hand milling machines.

New England

The summer lull in the machinery trade, if there is to be such a thing this year, is like the season—quite backward in coming forward. Business is good almost everywhere throughout the New England territory and no indication of a slowing down of operations appears. Buying continues active and heads of industries are optimistic of the immediate future and some are even forecasting continuance of activity for the remainder of the year.

The buying at the present time is representative of the principal lines of industry. Railroads, the automotive group and electric utility manufacturers are in the market for machinery for early deliveries. There is also good buying in prospect from foreign markets. Automatic machinery sales are better than at any corresponding time in the last four years. Contract manufacturers report that all the business they can handle for months ahead is booked and plenty more is offered.

Philadelphia

Business in the machine tool industry in the Philadelphia area for the first six months of this year was described by one of the largest producers as being "equally as good if not better" than it was in the corresponding period of 1925.

Some orders are coming in to the Philadelphia firms, and inuiries are favorable. The keen competition in the industry is being felt by the Philadelphia manufacturers and dealers, and hard work and superior salesmanship are resorted to to keep abreast of competitors.

The Illinois Central Railroad Co.'s recent order for machinery was a boon to the trade. Following the usual custom of that railroad the order was divided among several dealers. Philadelphia was represented in the distribution.

German Machinery Manufacturers Place Hopes in Future of Russian Market

Figures show Soviet government in great need of agricultural machinery and factory equipment—Germany's expectations are far beyond actual prospects for business

By Our Berlin Correspondent

In German foreign trade expectations Russia has for several years played the part of the great unknown quantity, promising unlimited possibilities. The Russian market has become the object of much speculation and many hopes. Economists, engineers and industrialists have figured out that Russia will need manufactured articles worth several billions in order to get her economic machinery into stride and German industry wants, like the rest of the world, to have a share in it.

The great hopes staked upon Russian business and the exertions made to secure it are not readily understood on the strength of sober facts as exhibited by pre-war trade returns. The balance of German-Russian trade was never on the right side. In 1913, Germany's record year of foreign trade, Russia consumed German goods to the value of 880 million marks, whereas Germany at the same time bought from Russia goods worth 1,400 million marks. Russia shared in the total of German imports to the extent of 13.2 per cent, but in the German exports only 8.7 per cent. Besides, Russia was never Germany's best market.

Russia Was Easy to Sell

The explanation of the preference it is being given among all foreign markets is no doubt that it was considered the easiest market. Russian demand and the German supply were tuned beautifully. German manufacturers knew exactly what Russia wanted and were always prepared to let her have it. Furthermore, they knew their way about, and all the little intricacies which in Russia preceded the conclusion of business were no secret to them.

When Russia a few years ago again came into the market backed by a huge bill of needs, German manufacturers were eager to rush to the rescue but then and there suffered their first disappointment. Instead of facing a large number of individual buyers they had to deal with an iron front which they found extremely difficult to penetrate.

The purchasing organization of the Russian Soviet State turned out to be a very hard nut to crack. Inquiries came in bewildering numbers, but business failed to materialize. The problem of payment was the reef on which many a prosperous looking contract foundered, and prices had to be cut down if business was to result. The purchasers for the Russian state were well informed as regards competitive prices in the whole world, and the margin of profit which used to make business with Russia so alluring before the war had dwindled more and more. Only after credit arrangements had been made with the help of German banks did trade come into swing.

The returns of the first year in which the revival of trade relations was really inaugurated, the year 1925, cannot be considered more than a modest start. The most significant feature of it is that again Russian import into Germany predominates. The export from Germany to Russia amounted to 156 million marks, whereas the import from Russia into Germany was 222 million marks. This import consisted as in pre-war times almost solely of raw materials, but the export from Germany to Russia was by no means entirely composed of manufactured products. Products of the machine building industry, including electrical machinery and vehicles, amounted to 52 million marks as against 175 million marks in 1913.

Farm and Factory Needs

As regards machinery, the demand of Russia is universal, encompassing nearly all branches of machine building but a preference for agricultural machinery and for factory equipment is unmistakable. The trend of demand can best be seen from the German returns of the first four months of the current year, which reflect it more clearly than the last year. The following figures represent the returns of the German machine export to Russia during the first four months of the current year; those for the same period of the year 1913 are added for comparison:

	Metric Tons 1926	1913
Steam turbines	80	812
Combustion motors	31	1,728
Air compressors	176	402
Excavation machinery	118	373
Sewing machines	45	1,101
Knitting machines	30	35
Machinery for refining wool	436	435
Cotton machinery	337	37
Spinning machinery	269	281
Weaving looms	27	477
Laundry machinery	30	100
Pumps and fire engines	115	343
Metal-working machine tools	1,521	3,200
Wood-working machinery	172	688
Agricultural machinery	10,161	5,519
Paper and wood pulp machinery	219	400
Pumps electrically driven	106	612
Hoisting machinery	121	968
Bookbinding machinery	130	252
Exhausters or ventilators	93	228
Shoemaking machinery	283	148
Machines for the ceramic industry	103	1,231
Printing presses	261	749
Passenger motor cars	4	797
Commercial motor vehicles	12	267

All classes of machinery not mentioned in this list do not figure in the export statistics of 1926 and if transactions have taken place they were too insignificant to be listed. Of such classes which in pre-war times enjoyed a fair amount of business with Russia, the following may be mentioned: locomotives, steam engines, cranes, machines and apparatus for the brewing, milling, and chemical industries, forging machinery, ore dressing machines, and refrigerating machinery.

From these figures it may be seen that the demand of Russia for machinery has changed, as it must be expected because of the distance Russia has been left behind in the progress of the world. Russia must for many years to come procure from abroad products of the machine building industry formerly manufactured in domestic works and this is one of the chief hopes upon which German machine builders are now banking.

U. S. Must Utilize Raw Materials to Fullest

In an address before a group of executives in New Haven recently, Arthur C. Foote, of the Bureau of Standards, stated that although the United States has but 6 per cent of the world's population, it furnishes 53 per cent of the world's production in nine basic industries, and it consumes 48½ per cent in these industries. And while we are the foremost industrial nation, our retention of that leadership must depend on our getting the maximum out of the raw materials with which we have been blessed.

"We like to consider that we have more automobiles than all the rest of the world, more telephones, more natural resources, and that we spend more on education," Mr. Foote said.

"But there is another side of the picture which is not so cheering. It is a picture of what we are paying for waste. Waste in production and distribution have done much to lower the purchasing power of the dollar to about five-eighths of what it was in 1913. That means a direct handicap on our purchasing power and a drag on our standards of living, which even now are higher than that of any people in history but which might be raised by elimination of waste.

"Some of these wastes may be roughly classified as follows: Speculation, seasonal operation, lack of statistics, lack of standards, too many varieties, non-uniform business practices, deterioration of commodities, inadequate transportation facilities, disorderly marketing, too many links in the distribution chain, bad credits, faulty understanding of economics, unscientific sales promotion, unfair practices, excessive use of materials, and destruction by fire."

The idea is not new, Mr. Foote said. Private enterprise has attacked the problem with considerable success. He cited the reduction from 180 sizes of electric lamp bases to 6, one of which is possible to use in any home or office.

Leaders in eight of the fields in which the Division of Simplified Practice has co-operated to eliminate excess variety have estimated their annual savings at nearly three hundred million dollars. These savings have come through lower inventories, lower labor costs, reduced selling expenses and smaller labor turnover, less idle investment, reduced seasonal operation, faster turnover of stocks, greater earning power for workers, better service to the consumer and better values.

Waste elimination bears an important relation to manpower, too, the speaker declared, for more effective and efficient use of our present resources will be possible when production and distribution are concentrated on smaller ranges of variety.

Handbook Ready for Distribution

More than 500 standards and recommended practices that have been approved by the Society of Automotive Engineers are now published in a single bound book. This is the S.A.E. Handbook for 1926, which is being distributed to members and to any others who have use for it from the headquarters of the society at 29 W. 39th St., New York. Revised editions are to be issued every six months, after the standards committee has acted on recommendations for new and revised standards at the annual and semi-annual meetings.

The book is of pocket size, 7¼x4¼x2¾ in., and contains more than 600 pages. It is bound in flexible leather covers and contains specifications, standards and recommended practices representing the cumulative results of the cooperative standardization efforts of the engineers from the beginning of automotive standardization work twenty years ago.

An index is included that lists only the products of suppliers who have filed with the society certificates specifying the parts and materials they are in position to furnish in accordance with the standards. This is in conformity with the certification plan of the U. S. Bureau of Standards.

Portable Machine Shop Visits Detroit

An interesting example of the length to which machine tool manufacturers are going in the education of their users, particularly mechanics in the various Detroit automobile factories, is to be seen in a special demonstration coach which recently made a tour of the Detroit factories under the joint supervision of the T. B. Rayl Co. and the Black & Decker Co.

The demonstration outfit in known as the "Clinic Coach," and has been in service for several months during which time it has visited most of the important manufacturing centers of the Eastern and Middle-Western states.

Personals

HOWARD C. WOGLOM has resigned as factory manager for Taylor & Fenn, of Hartford, Conn.

GEORGE EDWARDS has been appointed superintendent of the machinery division of the Peck, Stow & Wilcox Co., of Southington, Conn.

NATHAN A. BOWERS, Pacific Coast editor of *Engineering News-Record*, has received the degree of Doctor of Philosophy from Stanford University.

WILLIAM J. BUTLER has been appointed northern New England sales representative for the Bridgeport Brass Co., of Bridgeport, Conn. He will handle valves, brass pipe and tubular plumbing goods.

B. M. HORTER has been appointed manager of the Boston office of the Cutler-Hammer Manufacturing Co., of Milwaukee. Mr. Horter has been associated with this company for several years and previous to this appointment was manager of the company's Philadelphia office.

S. W. EATON has joined the Atlanta, Ga., branch office of the Worthington Pump and Machinery Co. Mr. Eaton has been identified with the company for several years.

R. W. GILLISPIE has been appointed vice-president and general manager of the Jeffrey Manufacturing Co., of Columbus, Ohio, manufacturer of conveying machinery.

G. A. OLOFSSON has been appointed vice-president and general manager of the Fenton Machine Tool and Die Co., of Fenton, Mich. C. J. Olofsson is vice-president and production manager.

ALMAR WESTMAN has been appointed secretary, treasurer and general manager of the newly organized Industrial Machine Tool Co., Inc., of Fenton, Mich. He was formerly associated with the Fenton Machine Tool and Die Co.

W. H. COURTNEY, formerly associated in the textile industry, has joined the Southeastern office of the S.K.F. Industries, Inc., as a textile engineering expert, and will specialize in this branch of the company's business in that territory.

L. H. BAILEY, formerly identified with the Murray Co., of Atlanta, has been appointed a special service engineer with the Southeastern branch of S.K.F. Industries, Inc., Healey Bldg., Atlanta, manufacturers of bearings. Mr. Bailey will cover the Southeastern territory, which includes Alabama, Georgia, Florida and Tennessee.

Business Items

The Maerky Machine Works, of 240 Cherry St., Philadelphia, has been appointed sales and service agent in Philadelphia and vicinity for the Climax Engineering Co., of Clinton, Iowa.

The entire stock and equipment of the Jos. F. McCoy Co., Inc., of New York, will be sold at auction on July 21. The Industrial Plants Corporation, of 25 Church St., New York, will handle the sale.

The George T. Trundle, Jr. Engineering Co. announces the official change of name of the organization to the Trundle Engineering Co., of Cleveland. There is no change in the organization, officers, trustees or staff.

George M. Bernstein & Co. has been organized by George M. Bernstein, who for many years had been associated with L. E. Emerman & Co., machine tool dealers of Chicago. Mr. Bernstein has established offices at 549 West Washington Blvd., and will specialize in new and used machine tools, hydraulic machinery and supplies.

The La Grange Iron Works, of La Grange, Ga., has announced that it will erect a new foundry and machine shop during the summer. About 11,000 ft. of space will be provided, with a daily output of 8,000 lb. of castings in the foundry department. It is stated that machinery for the shops has not yet been purchased.

The K. L. Jones Machinery Co., Healey Bldg., Atlanta, distributor of textile machinery in the Southeastern territory, announces the appointment of E. J. Upchurch, of Atlanta, as a Southeastern salesman. Mr. Upchurch was formerly identified with the Atlanta Textile Machinery Corporation, which he and his father, the late S. V. Upchurch, organized some years ago.

Articles of incorporation have been filed with the secretary of state in Indianapolis by the South Bend Engineering and Sales Corporation, at South Bend, Ind. The company is incorporated for the purpose of dealing in machinery, hardware, mechanical apparatus, implements and tools. The incorporators are: Herbert J. Lederer, William P. Kelly, Carl W. Ginz and Henry M. Harper.

The Bullard Machine Tool Co., of Bridgeport, Conn., reports very satisfactory sales for the first six months of this year. While the business for 1925 was fairly steady and in total volume equalled the quota set, the amount already on the books for six months of 1926 is considerably in excess of last year's figures for the same period. June sales are well up among the highest monthly totals ever booked by the company.

The Bullard plant is now equipped and manned for this activity and indications are favorable for continued operation at full capacity. A large proportion of orders originates in the automotive field, as this is the most active; but a satisfactory condition of general business is also reflected in the volume received from all lines of manufacturing. The railroad field is well represented.

Within a few days work will be started on the erection of a modern steel and concrete factory building at Indianapolis by the Morrison & Risman Co., Inc., of Buffalo, N. Y., for the reconstruction of railway track equipment, it was announced by R. L. Morrison, vice-president and treasurer of the corporation. The new plant will house machinery for the reconstruction of frogs, switches and similar track equipment and will provide employment for a number of skilled workmen. F. C. Cullem will be the manager of the plant.

Walter A. Wood announces his establishment in the field of industrial engineering. He will specialize in the determination of the field of application within which various types of equipment show the maximum economy of operation. Mr. Wood has been associated with several manufacturers and appraisers of industrial equipment and, for the past two years, has been studying the application of various types of office equipment for the Metropolitan Life Insurance Company. He is located at 151 Fifth Ave., New York City.

The New Haven Sherardizing Co., of Hartford, Conn., and the Metal Protection Corporation, of Indianapolis, Ind., are interested in the recent incorporation of the Chromilite Process Corporation, which has the following incorporators and officers: August F. Schoen, president; James E. Patten, vice-president, and Wesley I. Charter, treasurer. The new organization will specialize in rust-proofing, metal finishing and the chrome nickeling of steel, a process invented by James E. Patten, vice-president of the company. Immediate plans indicate the first unit will be established at Akron, Ohio, and future plans call for plants in Springfield, Mass., and in Hartford, Conn.

The annual outing of the office and engineering departments of the Farrel Foundry and Machine Co., of Ansonia, Conn., was held on June 26, at Double Beach, Conn.

Forthcoming Meetings

American Railway Tool Foremen's Association. Annual convention, Hotel Sherman, Chicago, Sept. 1, 2 and 3. G. G. Macina, secretary, 11402 Calumet Ave., Chicago.

American Railway Tool Foremen's Supply Association. Annual exhibit in connection with the annual convention of the American Railway Tool Foremen's Association, Chicago, Sept. 1, 2 and 3.

Machine Tool Exhibit. Sixth annual exhibition of machine tools at the Mason Laboratory, Yale University, under the auspices of the New Haven Section, A.S.M.E., the mechanical engineering department of the Sheffield Scientific School, and the New Haven Chamber of Commerce, Sept. 7 to 10. Administrative office, New Haven Machine Tool Exhibit, 400 Temple St., New Haven, Conn.

American Society for Steel Treating. Eighth national steel and machine tool exposition, Municipal Pier, Chicago, Sept. 20 to 24. W. H. Eisenman, secretary, 4600 Prospect Ave., Cleveland, Ohio.

Society of Automotive Engineers. Annual production meeting, Hotel Sherman, Chicago, Sept. 21, 22 and 23. John Warner, manager of meetings department, 29 West 39th St., New York.

American Foundrymen's Association. Second international foundrymen's congress, Detroit, Sept. 27 to Oct. 1, under Association. R. E. Kennedy, secretary, 909 the auspices of the American Foundrymen's W. California St., Urbana, Ill.

National Association of Manufacturers. Thirty-second annual meeting, Waldorf-Astoria Hotel, New York, Oct. 5, 6 and 7. George S. Boudinot, secretary, 50 Church St., New York.

National Safety Council. Fifteenth 25 to 29. A. A. Mowbray, director, 108 annual safety congress, Detroit, Mich., Oct. East Ohio St., Chicago.

The Weekly Price Guide

Rise and Fall of the Market

THE recent advance to $2 per 100 lb., Pittsburgh, on steel bars and shapes in carload lots, has not stimulated buying to any very great extent; quotations of $1.90 still appear on all three of the principal hot-rolled products, namely, bars, shapes and plates. Pig-iron buying is fairly active with no indications of price decline. Weakness continues in the steel sheet market; galvanized sheets are down 5c., blue annealed, 10c. and black, 15c. per 100 lb., compared with the June 25 level. Wiping cloths declined ½c. per lb. during the week. There is slight fluctuation in scrap lead and brass.

(All prices as of July 2)

IRON AND STEEL

PIG IRON—Per gross ton, f.o.b.:

CINCINNATI	
No. 2 Southern	$24.05
Northern Basic	24.27
Southern Ohio No. 2	23.27
NEW YORK—Tidewater Delivery	
Southern No. 2 (silicon 2.25@2.75)	27.37
BIRMINGHAM	
No. 2 Foundry	21.00
PHILADELPHIA	
Eastern Pa., No. 2x (silicon 2.25@2.75)	23.26
Virginia No. 2	28.67
Basic	22.26
CHICAGO	
No. 2 Foundry local	22.50
No. 2 Foundry, Southern (silicon 2.25@2.75)	25.05
PITTSBURGH, including freight charge ($1.76) from Valley	
No. 2 Foundry	20.27
Basic	20.27
Bessemer	20.27

IRON MACHINERY CASTINGS—Cost in cents per lb. of 100 flywheels, 6-in. face x 24-in. dia., hub not cored, good quality gray iron, weight 275 lb.:

Detroit	5.00@5.25
Cleveland	5.00@5.25
Cincinnati	5.00@5.50
New York	5.25@5.50
Chicago	5.25@5.75

SHEETS—Quotations are in cents per pound in various cities from warehouse; also the mill base in large lots.

Blue Annealed	Pittsburgh Mill Base	New York	Cleveland	Chicago
No. 10	2.30@2.50	3.89	3.15	3.50
No. 12	2.35@2.55	3.94	3.20	3.55
No. 14	2.40@2.60	3.99	3.25	3.60
No. 16	2.50@2.70	4.09	3.35	3.70
Black				
Nos. 18 to 20	2.80@3.05	4.30	3.65	3.90
Nos. 22 to 24	2.85@3.10	4.35	3.70	3.95
Nos. 26 and 27	2.90@3.15	4.40	3.75	4.00
No. 28	3.00@3.25	4.50	3.85	4.10
Galvanized				
No. 10	3.20@3.40	4.65	4.00	4.25
Nos. 12 to 14	3.30@3.50	4.75	4.10	4.35
No. 16	3.45@3.65	4.90	4.25	4.50
Nos. 18 to 20	3.60@3.80	5.05	4.40	4.65
Nos. 22 to 24	3.75@3.95	5.20	4.55	4.80
Nos. 26 and 27	3.90@4.10	5.35	4.70	4.95
No. 28	4.20@4.40	5.65	5.00	5.25

WELDED STEEL PIPE—Warehouse discounts are as follows:

	New York Black	New York Galv.	Cleveland Black	Cleveland Galv.	Chicago Black	Chicago Galv.
1 to 3 in. steel butt welded	53%	39%	55½%	43½%	58%	45%
2½ to 6 in. steel lap welded	48%	35%	53½%	40½%	55%	42%

Malleable fittings: Classes B and C, banded, from New York stock sell at list plus 4% less 5%. Cast iron, standard sizes, 36-5% off.

Size, Inches	List Price per Foot	Diameter in Inches — External	Diameter in Inches — Internal	Thickness Inches
1	$0.17	1.315	1.049	.133
1¼	.23	1.66	1.38	.14
1½	.27½	1.9	1.61	.145
2	.37	2.375	2.067	.154
2½	.58½	2.875	2.469	.203
3	.76½	3.5	3.068	.216
3½	.92	4.0	3.548	.226
4	1.09	4.5	4.026	.237
4½	1.27	5.0	4.506	.247
5	1.48	5.563	5.047	.258
6	1.92	6.625	6.065	.28

SEAMLESS STEEL TUBING—Following net prices are for seamless mechanical tubing, cold drawn, round, .10 to .30 carbon, at warehouse in lots of less than 100 ft.:

Thickness — Decimal	B.W.G. and Fractions	Outside Diameter in Inches — ⅛	¼	⅜	½	1	1¼	1½
		Price per Foot						
.035″	20	$0.15	$0.16	$0.17	$0.18	$0.19	$0.21	$0.23
.049″	18	.17	.18	.19	.20	.21	.23	.25
.065″	16	.19	.20	.21	.22	.23	.25	.27
.083″	14	.20	.22	.23	.24	.25	.27	.29
.095″	13	.21	.23	.25	.26	.27	.29	.31
.109″	12	.22	.24	.26	.27	.28	.30	.32
.120″ or .125″	11	.23	.25	.27	.28	.29	.31	.33
.134″	10	.24	.26	.28	.29	.30	.32	.34

MISCELLANEOUS—Warehouse prices in cents per pound in 100-lb. lots:

	New York	Cleveland	Chicago
Spring steel (light) (base)*	7.00	6.00@7.50	4.65†
Spring steel (heavier)	4.00	....	4.00
Coppered Bessemer rods (base)	6.05	6.00	6.20
Hoop steel	4.49	3.65	4.15
Cold rolled strip steel	6.25	6.35	6.25
Floor plates	5.25	5.30	5.00
Cold drawn shafting or screw	4.00	3.90	3.60
Cold drawn flats, squares	4.50	4.40	4.10
Structural shapes (base)	3.34	3.10	3.10
Soft steel bars (base)	3.24	3.00	3.00
Soft steel bar shapes (base)	3.24	3.00	3.00
Soft steel bands (base)	3.99	3.20	3.65
Tank plates (base)	3.34	3.20	3.10
Bar iron (3.00 at mill)	3.24	3.21	3.00
Drill rod (from list)	60@65%	55%	50%

Electric welding wire, New York, ⅛″, 8.35c.; ¼, 7.85c.; ⅝ to ½, 7.35c. per lb. *Flat, ⅛@½-in. thick. †F.o.b. cars.

METALS

Current Prices in Cents Per Pound

Copper, electrolytic (up to carlots), New York			15 12½
Tin, 5-ton lots, New York			63.37½
Lead (up to carlots) E. St. Louis	8.10	New York	8.85
Zinc (up to carlots) E. St. Louis	7.20	New York	8.12½

	New York	Cleveland	Chicago
Antimony (Chinese), ton spot	14.00	15.50	15.00
Copper sheets, base	22.50	22.50	22.50
Copper wire, base	19.25	16.50	16.00
Copper bars, base	22.12½	22.12½	21.87½@22.12½
Copper tubing, base	24.25	24.25	24.25
Brass sheets, base	18.87½	18.87½	18.87½
Brass tubing, base	23.50	23.50	23.50
Brass rods, base	16 62½	16.62½	16.62½
Brass wire, base	19 37½	19.37½	19.37½

Shop Materials and Supplies

METALS—Continued

	New York	Cleveland	Chicago
Aluminium ingots, 98 to 99%, 1 to 15 ton lots	27.00	27.00	27.02
Zinc sheets (casks)	12.75	12.55	11.51
Solder (½ and ½), (case lots)	39.12½	40.00	38½@42½

Babbitt metal, delivered, New York, cents per lb.:

Genuine, highest grade	76.37½
Commercial genuine, intermediate grade	54.50
Anti-friction metal, general service	30.50
No. 4 babbitt (f.o.b.)	13.87½

Nickel, f.o.b. refinery, cents per lb.:

Ingots..... 31.00 Electrolytic.. 38.00 Shot.....32.00

SPECIAL NICKEL AND ALLOYS—Price in cents per lb., f.o.b. Huntington, W. Va.:

Hot rolled nickel sheet (base)	52.00
Cold rolled nickel sheet (base)	60.00
Hot rolled rods, Grade "A" (base)	50.00
Cold drawn rods, Grade "A" (base)	58.00
Manganese nickel hot rolled rods "E"—low manganese (base)	54.00
Manganese nickel hot rolled rods "D"—high manganese (base)	57.00

Base price of Monel metal in cents per lb., f.o.b. Huntington, W. Va.:

Shot	32.00	Hot rolled rods (base)	40.00
Blocks	32.00	Cold drawn rods (base)	48.00
Ingots	38.00	Hot rolled sheets (base)	42.00
Cold rolled sheets (base)			50.00

OLD METALS—Dealers' purchasing prices in cents per pound:

	New York	Cleveland	Chicago
Crucible heavy copper	12.00 @12.25	11.25	11.25@11.75
Copper, heavy, and wire	11.25 @11.75	11.50	10.75@11.25
Copper, light, and bottoms	9.62½@10.12½	9.75	9.75@10.25
Heavy lead	7.12½@ 7.37½	6.50	6.50@ 7.00
Tea lead	5.00 @ 5.50	5.00	5.50@ 6.00
Brass, heavy, yellow	7.00 @ 7.25	7.25	7.50@ 8.00
Brass, heavy, red	9.25 @ 9.75	9.50	8.75@ 9.25
Brass, light	5.75 @ 6.00	6.00	6.75@ 7.25
No. 1 yellow rod turnings	8.00 @ 8.50	8.00	7.75@ 8.25
Zinc	4.25 @ 4.75	4.00	4.25@ 4.75

TIN PLATES—American Charcoal—Bright—Per box

		New York	Cleveland	Chicago
"AAA" Grade:				
IC,	14x20	$12.10	$11.95	$11.50
"A" Grade:				
IC,	14x20	9.70	9.90	9.50
Coke Plates—Primes—Per box				
100-lb.,	14x20	6.45	6.10	7.00
Terne Plates—Small lots, 8-lb. Coating—Per box				
IC,	14x20	7.75@8.00	6.95	7.50

MISCELLANEOUS

	New York	Cleveland	Chicago
Cotton waste, white, per lb.	$0.13@0.17½	$0.18	$0.15@0.20
Cotton waste, colored, per lb.	.10@ .14	.14	.12@.17
Wiping cloths, washed white, per lb	.17½	36.00 per M	.16
Sal soda, per 100 lb. keg	2.05	2.25	2.75*
Roll sulphur, per 100 lb	3.60†	3.50	4.25‡
Linseed oil, per gal., 5 bbl. lots	.89½	.96	.94
Lard cutting oil, 25% lard, per gal.	.55	.50	.48
Machine lubricant, medium-bodied (55 gal. metal bbl.), per gal.	.35	.35	.29
Belting—Present discounts from list in fair quantities (½ doz. rolls).			
Leather—List price, 24c. per lin. ft. per inch of width for single ply.			
Medium grade	40–5%	40–5%	40–5%
Heavy grade	30–10%	30–10%	30–10%
Rubber transmission, 6-in., 6 ply, $1.83 per lin. ft.			
First grade	50%	50–10%	50%
Second grade	50–10%	60–5%	50–10%

*In 175 lb. kegs. † Per 150 lb. lot. ‡In 425 lb. barrels

Comparative Warehouse Prices

New York	Unit	Current Price	Four Weeks Ago	One Year Ago
Soft steel bars	per lb.	$0.0324	$0.0324	$0.0324
Cold drawn shafting	per lb.	.04	.04	.0415
Brass rods	per lb	.1662½	.1662½	.1587½
Solder (½ and ½)	per lb.	.3912½	.3837½	.395
Cotton waste	per lb.	.13@.17½	.13@.17½	15@22
Washers, cast iron (½ in.)	per 100 lb.	7.00	7.00	7.00
Emery disks, cloth, No. 1, 6 in. dia.	per 100	3.55	3.55	3.38
Lard cutting oil	per gal.	.55	.55	.55
Machine oil	per gal.	.35	.35	35
Belting, leather, medium	off list	40–5%	40–5%	30–10%
Machine bolts, up to 1x30 in.	off list	40%	40%	40%

MISCELLANEOUS—Continued

	New York	Cleveland	Chicago
Abrasive materials—In sheets 9x11 in., No. 1 grade, per ream of 480 sheets:			
Flint paper	$5.56	$5.84	$5.65
Emery paper	10.71	11.00	10.71
Emery cloth	29.48	31.12	29.48
Emery disks, 6 in. dia., No. 1 grade, per 100:			
Paper	1.49	1.45	1.49
Cloth	3.55	3.55	3.20
Fire clay, per 100 lb. bag		.60	.75
Coke, prompt furnace, Connellsville	per net ton	2.75@	3.00
Coke, prompt foundry, Connellsville	per net ton	4.00@	4.50
White lead, dry or in oil	100 lb. kegs	New York, 15.25	
Red lead, dry	100 lb. kegs	New York, 15.25	
Red lead, in oil	100 lb. kegs	New York, 16.75	

SHOP SUPPLIES

Machine bolts, ¼x1½-in., per 100, $1.70. Discount at New York warehouses on all sizes up to 1x30-in., 40%; 1⅛ and 1¼x3-in. up to 12-in., 15%; with cold punched hex. nuts up to 1-in. dia. (plus std. extra of 10%) 30%; with hot pressed hex. nuts up to 1x30-in. (plus std. extra of 10%) 35%.

Carriage bolts, ¼x1½-in., per 100, $1.00. Discount on all sizes up to 1x30-in., 30%.

Coach and lag screws, 1½x$\frac{7}{16}$in., $2.25 per 100, less 40%.

Tap bolts, 1½x½-in., $1.00 per 100. List plus 35% at New York warehouses.

Bolt ends, 1x12-in., 10c. per lb., less 40%.

Nuts, semi-finished, ½x½-in., 2c. each. Discount 70% for $\frac{9}{16}$-in and smaller and 65% for ⅝-in. and larger.
Case hardened ½x½-in., 6c. each, less 50%.

Rivets, button heads, ¾-in., ½-in., 1-in. diam. x2$\frac{7}{16}$-in. to 4½-in. $5.00* per 100 lb. at New York warehouses; cone heads, same sizes, $5.20* per 100 lb. Rivets, $\frac{7}{16}$x1-in. and longer, 19c. per lb., less 50%. Same discount for tinned. EXTRA per 100 lb. for 1½ to 2-in. long, all diameters, 25c.; ½-in. dia., 35c.; ⅜-in. dia., 75c; 1-in. long and shorter, 75c.; longer than 5-in., 50c.; less than 200 lb. 50c.; countersunk heads, 45c.

Washers, cast iron, ½-in., $7.00* per 100 lb. at New York warehouses; ⅜-in., $6.00* per 100 lb.

*For immediate delivery from warehouse.

Machine Requirements and Industrial Construction

Machine Tools and Equipment Wanted

Mass., Boston — School House Dept., City Hall — Metal working machinery for Jamaica Plain and Mechanics Art High Schools.

Mass., Boston—South End Battery Co., 137 Dover St.—test bench, growler, lathe, undercutter for testing armatures and starters.

Mich., Detroit—Superior Piston Ring Co., 6425 Epworth Blvd.—machine equipment for expansion of piston ring manufacturing plant.

Mich., Pontiac—General Motors Corp., Oakland Motor Car Co.—Equipment for assembly plant, etc., for proposed factory group.

N. J., Newark — Leiman Bros., 175 Christe St.— No. 10 Brown & Sharpe plain grinder; No. 4 Warner & Swazey universal lathe; and 20 in. Barnes Camel back drill with tapping attachment.

Opportunities for Future Business

Calif., Bishop — State Highway Comn., Sacramento, is receiving bids until July 19, for the construction of maintenance shop, etc., here. R. M. Morton, Forum Bldg., Sacramento, State Highway Engr.

Calif., Oakland—Willys-Overland Pacific Co., 5601 East 14th St. plans the construction of assembling plant extensions, 100,000 sq.ft., on recently purchased site East 14th St.

Calif., Richmond — Duncanson-Harrelson Co., De Young Bldg., San Francisco, will build warehouse, shops, etc. by day labor. $75,000.

Calif., Santa Cruz—M. H. Merrill, et al, 1 Drumm St., San Francisco, plans the construction of an industrial school to specialize in Diesel engineering here. Estimated cost $500,000.

Conn., Danbury—Packard Motors Co., 170 Cannon St., Bridgeport awarded contract for the construction of a 1 story, 60 x 150 ft., service station, here. Estimated cost $50,000.

Conn., Hartford—Hartford Empire Co., 347 Homestead Ave., had plans prepared for the construction of 3 story factory, Homestead Ave. Estimated cost $50,000.

Conn., Hartford—Royal Typewriter Co., 150 New Park Ave., awarded contract for the construction of 2 story, 95 x 210 ft. factory, on New Park Ave., here. Estimated cost $150,000. Noted June 24.

Ill., Abingdon—Abingdon Sanitary Mfg. Co., plans the construction of six one story buildings for the manufacture of plumbing supplies, etc., here. Estimated cost $650,000. S. Cutler, 137 South La Salle St., Chicago, Archt.

Ill., Chicago—American Car & Foundry Co., 2417 S. Paulina St., plans the construction of a 100 x 313 ft. factory at 2605-2617 S. Wood St. Estimated cost $25,000. E. C. Stolberg, New York, N. Y., Archt.

Ill., Chicago—Appleton Electric Co., 1706 Wellington Ave., awarded contract for the construction of a 4 story, 70 x 300 ft. factory for manufacture of conduit fittings, etc. at 1706 Wellington Ave.

Ind., Newcastle—Hoosier Kitchen Cabinet Co., will build 3 story kitchen cabinet factory, here. Work will be done by separate contracts.

Mass., Boston — Forsyth Garage Corp., c/o S. S. Eisenberg, 46 Cornhill, Archt., awarded contract for the construction of a 2 story, 180 x 190 ft. repair and service garage, 70 Forsyth St. Estimated cost $150,000. Noted July 1.

Mass., Boston — Mason & Hamlin Co., 560 Harrison Ave. awarded contract for the construction of 3 story, addition to piano factory. Estimated cost $40,000.

Mass., Cambridge (Boston P. O.)—Washington Auto Trust, D. M. Robb, 1800 Massachusetts Ave., awarded contract for the construction of 1 story, repair garage. Estimated cost $40,000. Noted June 24.

Mass., Holyoke—W. G. Mengel, 33 Railroad St. awarded contract for the construction of a 1 story, repair garage and show room on Elm St. Estimated cost $59,000.

What This Section Is

Machinery Requirements and Industrial Construction is a reliable machinery market, because every item is reported first-hand by our own correspondents, scattered over the United States and Canada. These leads are verified by our men. We do not use newspaper clippings, nor do we listen to any hearsay or rumors. These sales leads are as accurate as our men can make them, and as timely as weekly publication will permit.

This market is for *American Machinist* subscribers. It covers the same machinery fields as does the paper. Here will be found inquiries for machine tools, presses, hammers, welding, forging and heat treating equipment, and other machinery for the shop.

Here also will be found reports of proposed industrial construction, where sooner or later machinery will be needed.

Are you making the most of the opportunities listed here?

Mass., Jamaica Plain (br. Boston)—Buff & Buff Mfg. Co., Green St. having plans prepared for the construction of a 2 story, factory addition for the manufacture of surveying instruments, Green St. Estimated cost $40,000.

Mich., Pontiac — General Motors Corp., Oakland Motor Car Co., awarded contract for the construction of 2 story, 50 x 2,000 ft. assembly plant, etc., for factory group. Estimated cost $5,000,000. Noted June 24.

Mo., Kansas City—G. F. Green, Rialto Bldg., Archt. and Contractor, and T. M. Murphy, 409 Sharp Bldg., having plans prepared 4 story 110 x 142 ft. garage, Wyandotte St. north of 11th St. Estimated cost $200,000.

Mo., Kansas City — Mack International Truck Co., 2605 Warwick Blvd., E. Lang, Local Mgr. plans garage and salesroom here. Estimated cost $75,000. Private plans.

N. J., Newark—Weber & Scher Mfg. Co., 263 Sussex Ave., manufacturer of machinery and parts, plans 1 story machine shop addition. Estimated cost $23,000.

N. J., Newark — L. J. Wing Mfg. Co., Victoria St., manufacturers of fans, blowers, etc. awarded contract for the construction of 1 story addition to plant, on Frelinghuysen Ave. Estimated cost $50,000. Noted June 3.

N. Y., Albany—International Plumbing Co., Tivoli St., had plans prepared, 2 story and basement storage and distributing plant, including pipe-cutting, threading, etc. departments. Estimated cost $125,000 including equipment.

N. Y., New York — Two Hundred Fifty West 25th St., Corp., N. B. Singer, pres. having plans prepared for the construction 5 story, garage, at 250 West 25th St. Estimated cost $75,000. Jardine, Hill & Murdock, 347 Madison Ave. Engrs. and Archts.

N. Y., Richmond Hill (Jamaica P. O.)—Gode Bros., 9149 118th St., taking bids 1 story, 90 x 100 ft., machine and repair works. H. T. Jeffrey, Jr., 155 Jamaica Ave., Jamaica, N. Y., archt.

O., Akron—City, W. F. Peters, Dir. Pub. Service, awarded contract for the construction of a 1 and 2 story, 156 x 280 ft., garage, Johnston St. Estimated cost $150,000. Noted June 24.

O., Columbus—W. H. Duffy, Dir. Public Service will receive bids until July 13, for the construction of a 2 story, 80 x 180 ft., garage and shop for the waterworks department. Estimated cost $110,000.

O., Marietta—Rand Kardex Co., Tonawanda, N. Y. having plans prepared for the construction of 5 story, 88 x 100 ft. steel cabinet manufacturing plant on Greene St., here. Estimated cost $125,000. Private plans.

O., Marietta—GARAGE—E. L. Stephens, awarded contract for the construction of a 1 story, 90 x 130 ft. garage on 3rd St. Estimated cost $55,000.

O., Toledo—Edward N. Riddle Co., 27 Broadway, plans the construction of plant for the manufacture of electrical fixtures, including machine shop and foundry on recently purchased 6½ acre site, Fearing St. and New York Central R.R. tracks, here. Estimated cost $500,000.

Pa., Clairton — Carnegie Steel Co., Carnegie Bldg., Pittsburgh, awarded contract for the construction of 366 additional by product ovens at plant, here. Estimated cost $16,000,000. Noted Feb. 25.

Pa., Philadelphia—J. Brady, 136 South 4th St., will soon award contract for the construction of a 4 story, 97 x 98 ft. garage at 924-929 Race St. Estimated cost $150,000. I. T. Catharine, Franklin Trust Bldg., Archt.

Tenn., Chattanooga — Chattanooga Trust Co., 1st Natl. Bank Bldg., having plans prepared for the construction of 75 x 200 ft. garage on Market St. near 4th St. Estimated cost $50,000. C. E. Beardon, 1st Natl. Bank Bldg., Archt.

Va., South Boston (Boston P. O.)—South Boston Mfg. Co. plans the construction of a wagon factory here to replace fire loss.

Wis., Milwaukee—Badger Meter Mfg. Co., 841 13th St. soon awards contract for the construction of a 2 story, 61 x 120 ft. manufacturing addition to plant at 13th and Meinecke Ave. T. Tullgren & Sons, 9 Waverly Pl., Archts.

Wis., Racine — American Skein and Foundry Co., 2300 Racine St., awarded contract for the construction 1 story, 90 x 100 ft. factory for piano plate finishing rooms, etc. Estimated cost $40,000.